EARTH RADIATION BUDGET EXPERIMENT

(ERBE)

DATA MANAGEMENT SYSTEM

REFERENCE MANUAL

VOLUME V(a)

Section 5.0 through Section 5.8

SECTION 5. INVERSION

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PREFACE

This document describes the final release of the ERBE Data Management System. It represents the combined efforts of the ERBE Data Management Team along with inputs from members of the ERBE Science Team. The document is an update of the Release 3 Design Document and reflects final changes which resulted from coding and testing of the flight data processing system.

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The Reference Manual is separated into nine volumes. Each volume is the work of a subsystem design team which developed specifications, designed the subsystem, and reviewed the design before a panel of Data Management and Science Team Representatives.

ACKNOWLEDGEMENTS

The Inversion Subsystem Design Team has gained a new insight for the scope of effort required in assembling an ERBE Reference Manual. In particular, the realization that our handwritten notes and illustrative scribbles were an unacceptable final format provided reason for considerable consternation. With this in mind, the authors express their sincere appreciation to Joanne Saunders for her enthusiastic support through endless cycles of typing and modifying the text and to Yvonne Seaman for her patience in preparing and revising countless figures and illustrations.

NOTES TO READERS

This Reference Manual represents the efforts of the ERBE Data Management Team, in particular the Inversion Subsystem Design Team, to document and to provide the reader with an understanding of the Inversion Subsystem software. The manual is contained in two volumes which are organized into sections that are numbered according to the corresponding software module numbers, where appropriate. Volume V(a) contains Section 5.0 through 5.8, and Volume V(b) contains the appendices, Sections A through H.

Section 5.0 provides an overview of the Inversion Subsystem and a general description of the Main-Processor. Sections 5.1 through 5.4 describe the initialization, scanner, nonscanner, and final processing phases of the Main-Processor. Section 5.5 describes the Post-Processor. The Monthly-Processor is discussed in Section 5.6, and various output product packing programs are described in Section 5.7. Section 5.8 contains a list of references.

Input and output products are described in Appendix A and Appendix B. Copy procedures and dump programs are discussed in Appendices C and D. Symbols, abbreviations, and module names are contained in Appendix E. Appendix F contains definitions of COMMON Block variables as well as Subroutine/COMMON Block matrices showing in which subroutines the various COMMON Blocks are located. Detailed descriptions of each general Inversion Subsystem module are provided in Appendix G. Appendix H contains Subsystem product naming conventions and gives a brief discussion concerning the interface between the user and the Inversion Subsystem job control language and between the job control language and the FORTRAN programs.

Section/module numbers are often indicated in this manual by the “#” symbol followed by the appropriate module number. For example, PARINT, #5.1.2 shows that subroutine PARINT is module #5.1.2 and is described in Section 5.1.2; similarly SFAC2, #G.5.9.2 shows that function SFAC2 is module #G.5.9.2 and is described in Section G.9.2. Modules designated as G.5 are “general” routines (called from more than one module). The “5” indicates that the module belongs to the Inversion Subsystem.

Throughout this document the following conventions are adhered to concerning parameter descriptions.

SYMBOL	DESCRIPTION
$\hat{X}$	Estimate or unit vector
$\overline{X}$	Arithmetic mean
x	Scalar
$\mathbf{x}$	Vector array, matrix or 2 or more dimensional array

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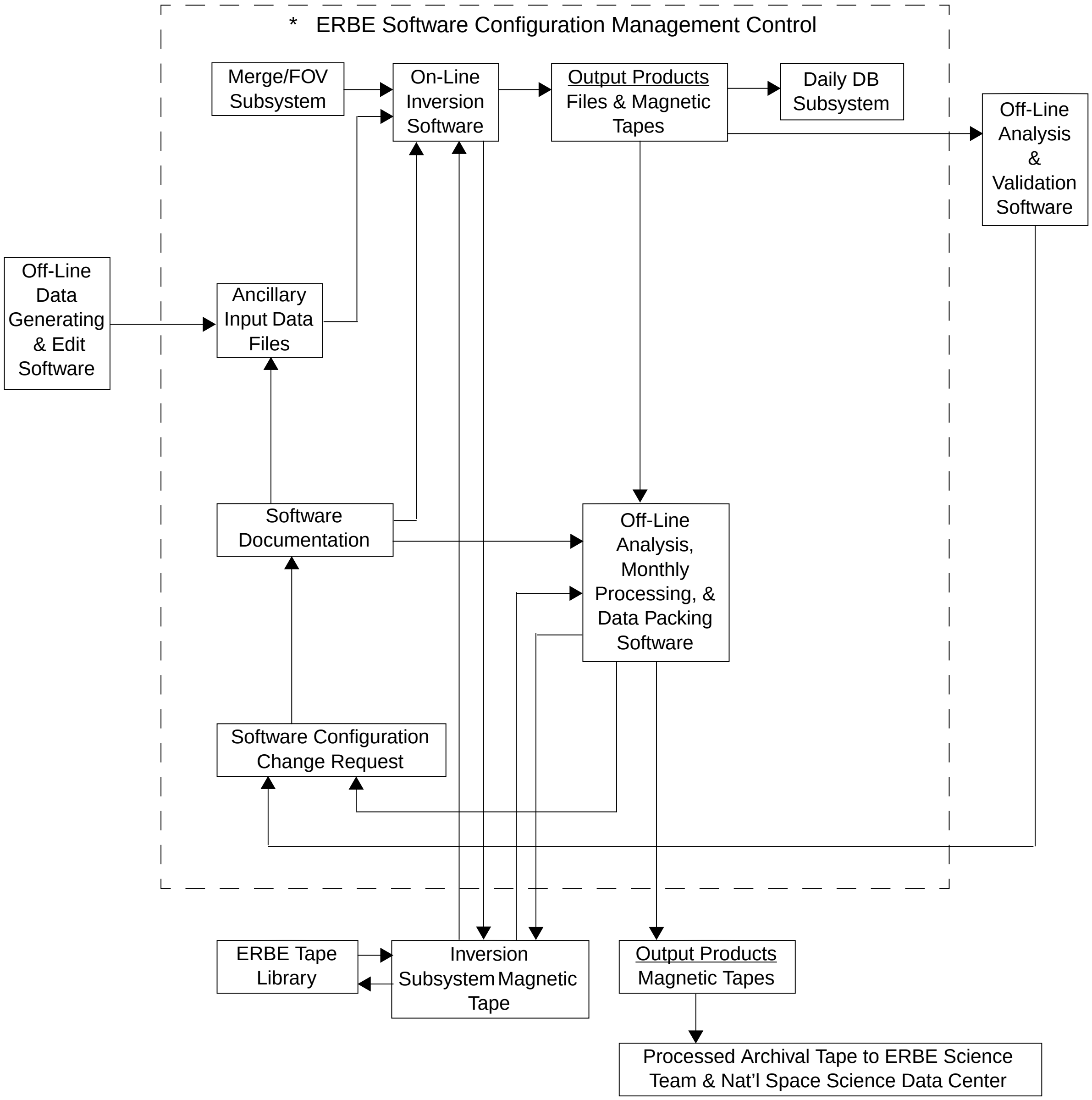
5.0 GENERAL

The Inversion Subsystem reduces satellite altitude measurements from the scanner ($wm^{-2}sr^{-1}$) and nonscanner (wm^{-2}) instruments to radiant exitances (wm^{-2}) at the top of the atmosphere (TOA) or reference level. These radiant exitances are interpreted as estimates of the average radiant exitance over colatitude and longitude regions defined on the Earth equatorial-Greenwich grid system. Scanner data are used to define 2.5-deg regional averages. Nonscanner data are used to define 5-deg and 10-deg regional averages.

The Inversion Subsystem consists of a Main-Processor, Post-Processor, Monthly-Processor, product packing programs, product copy procedures, product dump programs, magnetic tape data base management software, and several programs required to generate ancillary input data. The Main-Processor and Post-Processor constitute the Inversion Subsystem on-line software. The primary purpose of the Main-Processor is to determine regional scene information and to work the inversion problem as briefly described below. The Post-Processor merges data files from the Main-Processor and prepares the unpacked Processed Archival Tape (PAT60, ID-24). In the case of a “restart” (see Section A.2), all data previously placed on the PAT60 by the Inversion Subsystem are replaced with newly calculated values or default values. Both the Main-Processor and the Post-Processor generate additional output products. The Monthly-Processor generates the Earth Target Validation Data (ETVD, V-6) product and the Medium-Wide FOV Data Tape (MWDT, S-7) product. The Processed Archival Tape (PAT, S-8) and the packed Scanner and Nonscanner Scene Validation Data product (ID-25) are generated by off-line packing programs. Figure 5.0-1 (Page 1) shows an overview of the Inversion Subsystem, and Figure 5.0-1 (Page 2) depicts schematically the input/output interfaces of the Inversion Subsystem.

The first function of the Main-Processor is to initialize the system utilities and required processing and control parameters. During subsystem initialization the collation weight table as discussed in Section A.4 is redefined. The header record of the pre-Processed Archival Tape (pre-PAT, ID-3) from the Merge-FOV Subsystem (see Reference 1) is verified. Also, it is determined whether the spacecraft is in a circular or elliptical orbit, and a table of validation data time periods is calculated for later use by the



* Software inside dashed box is under configuration management.

Figure 5.0-1. Inversion Subsystem Overview and Interfaces (1 of 2)

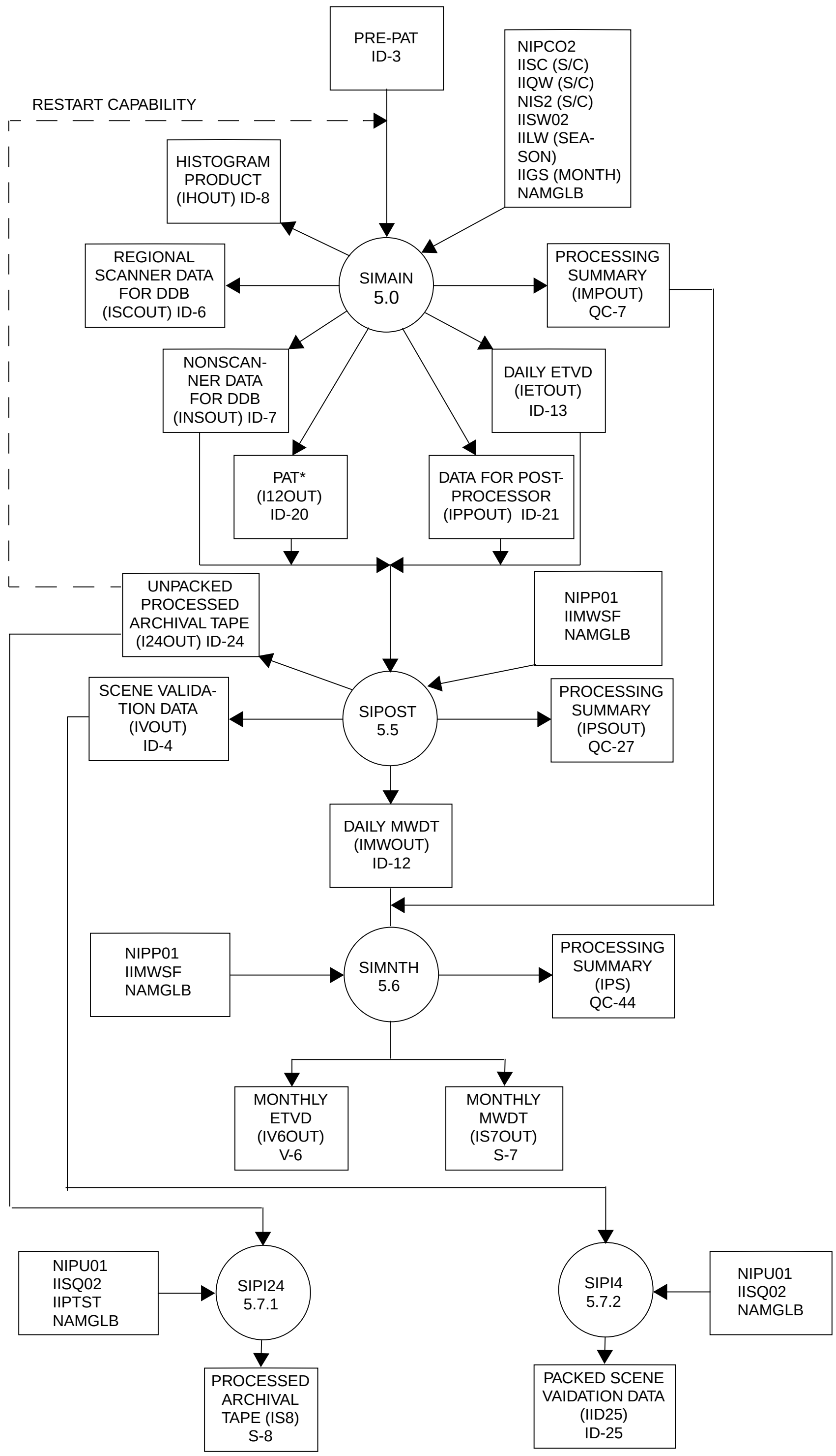


Figure 5.0-1. Inversion Subsystem Overview and Interfaces (2 of 2)

Post-Processor to generate the Scanner and Nonscanner Scene Validation Data product (ID-4).

Following subsystem initialization, scanner data and nonscanner data are processed alternately. Scanner measurements are processed individually and grouped according to 2.5-deg regions. These processed data including averaged radiant exitances, scene information, and other regional statistics are output to the Daily Data Base Subsystem. The regional scene information is saved during this phase for later nonscanner processing. Individual filtered scanner measurements from the shortwave, longwave, and total channels provided by the Merge-FOV Subsystem are unfiltered by the spectral correction algorithm. These unfiltered measurements, m, are inverted to radiant exitances, $\hat{M}$, at the TOA by

$$\hat{M} = \frac{\pi m}{b}$$

where b is a value from either a shortwave bidirectional model or a longwave anisotropic model.

Nonscanner measurements are accumulated over 32-sec time intervals during scanner processing. Certain subsystem control parameters initiate a switch from scanner to nonscanner processing. Following this switching, the accumulated nonscanner measurements are reduced to four 32-sec radiometric averages. These average measurements correspond to medium field-of-view (MFOV) and wide field-of-view (WFOV) measurements of both shortwave and longwave radiation. A set of influence coefficients is calculated over this 32-sec time interval for each of these four cases based on the scene information from scanner processing.

The average nonscanner measurements are inverted to TOA estimates by two different techniques. One uses a shape factor algorithm and the other uses a numerical filter algorithm. Inversion by the shape factor technique is accomplished by

$$\hat{M}_i^{SF} = \frac{m_i}{s_i}$$

where s_i is the shape factor calculated from the influence coefficients associated with the average measurement, m_i. Each estimate, $\hat{M}_i^{SF}$, is assumed to represent the average radiant exitance over the 10-deg region that contains the nadir point.

Inversion by the numerical filter technique (of degree n) to get to a TOA estimate for the same average measurement, m_i, requires the n consecutive average measurements on either side of the i^{th} measurement and the set of influence coefficients associated with each of these measurements. The 2n + 1 sets of influence coefficients are organized into a square matrix, and the matrix is inverted. The elements from the middle row of the inverted matrix are taken as the inversion weights, ω_j, so that the estimated radiant exitance at the TOA becomes,

$$\hat{M}_i^{NF} = g \sum_{j=i-n}^{i+n} \omega_j m_j ,$$

where g = 1 for longwave estimates, and g is a function of scene and geometry for shortwave estimates. Each estimate, $\hat{M}_i^{NF}$, is assumed to represent the average radiant exitance over the 5-deg region that contains the nadir point.

Figure 5.0-2 shows the structure of the Inversion Subsystem Main-Processor, and Figure 5.0-3 illustrates the data processing flow. A flow diagram of INVERT (#5.0), the Inversion Subsystem Main-Processor driver program, is given in Figure 5.0-4.

Detailed descriptions of each processing module are contained in the following sections. Input/output products are described in Appendix A and Appendix B. Copy procedures and dump programs are discussed in Appendices C and D. Symbols, abbreviations, and module names are contained in Appendix E. Appendix F contains definitions of COMMON Block variables as well as Subroutine/COMMON Block matrices showing in which subroutines the various COMMON Blocks are located. Detailed descriptions of each general Inversion Subsystem module are provided in Appendix G. Appendix H contains Subsystem product naming conventions and gives a brief discussion concerning the interface between the user and the Inversion Subsystem job control language and between the job control language and the FORTRAN programs.

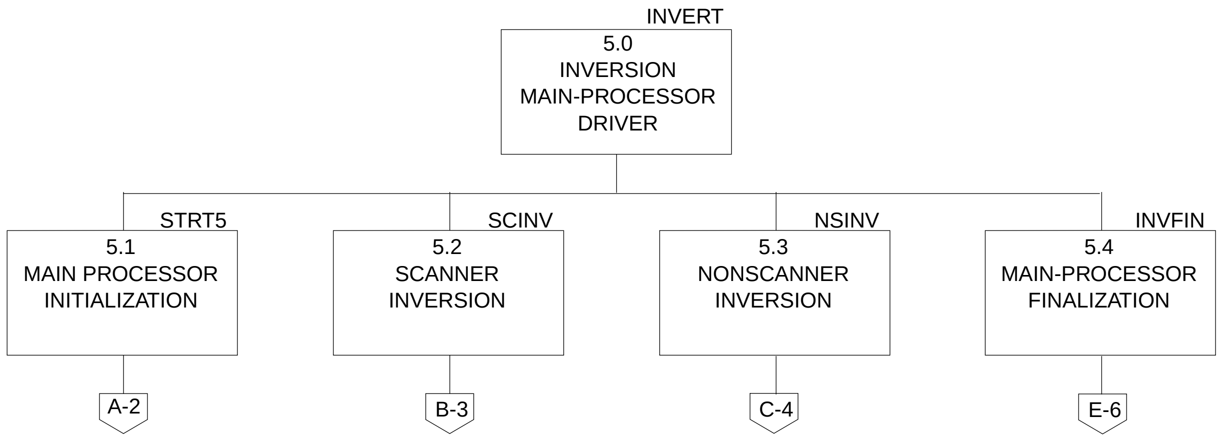


Figure 5.0-2. Inversion Subsystem Main-Processor Functional Structure Chart (1 of 6)

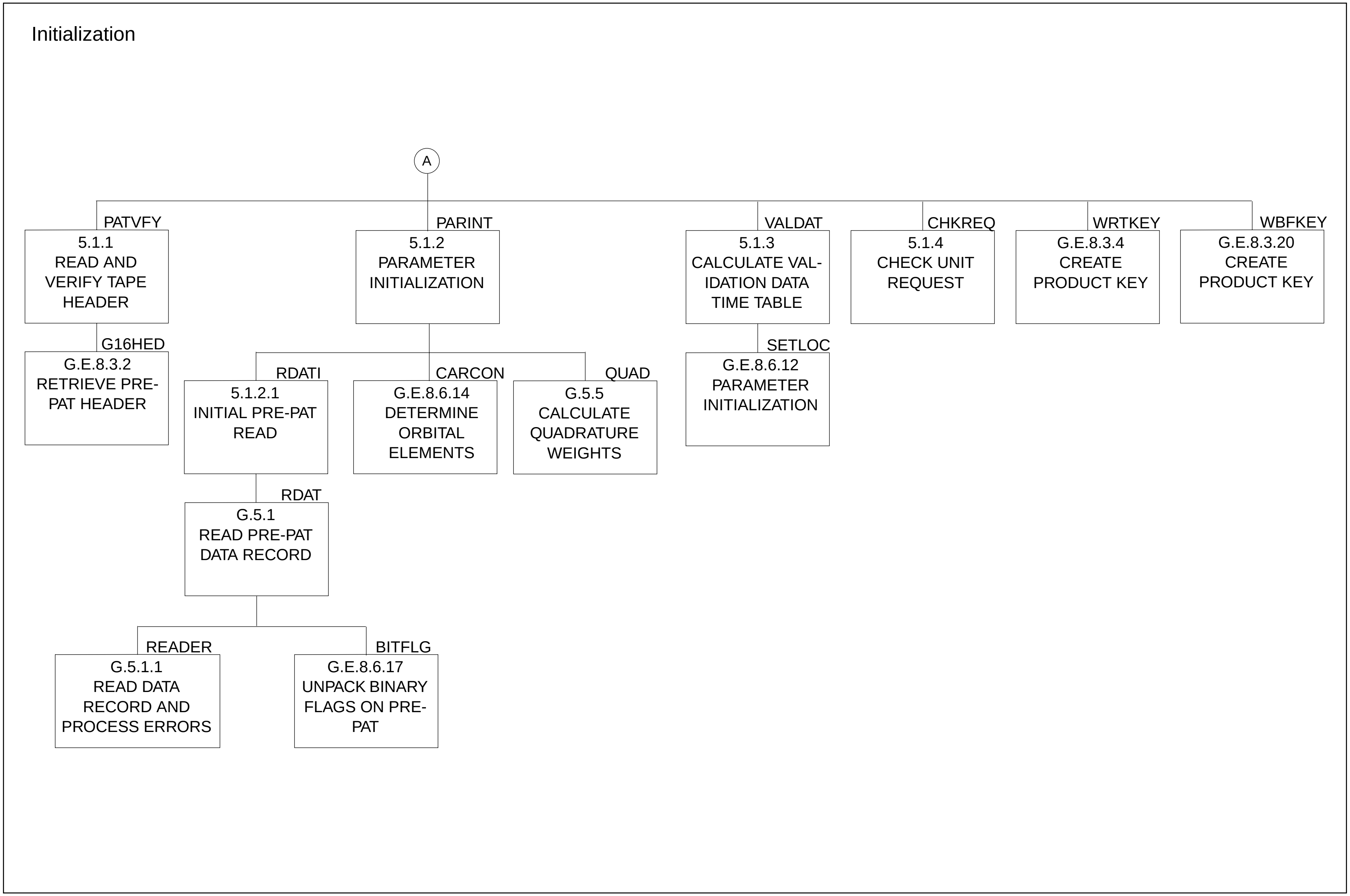


Figure 5.0-2. Inversion Subsystem Main-Processor Functional Structure Chart (2 of 6)

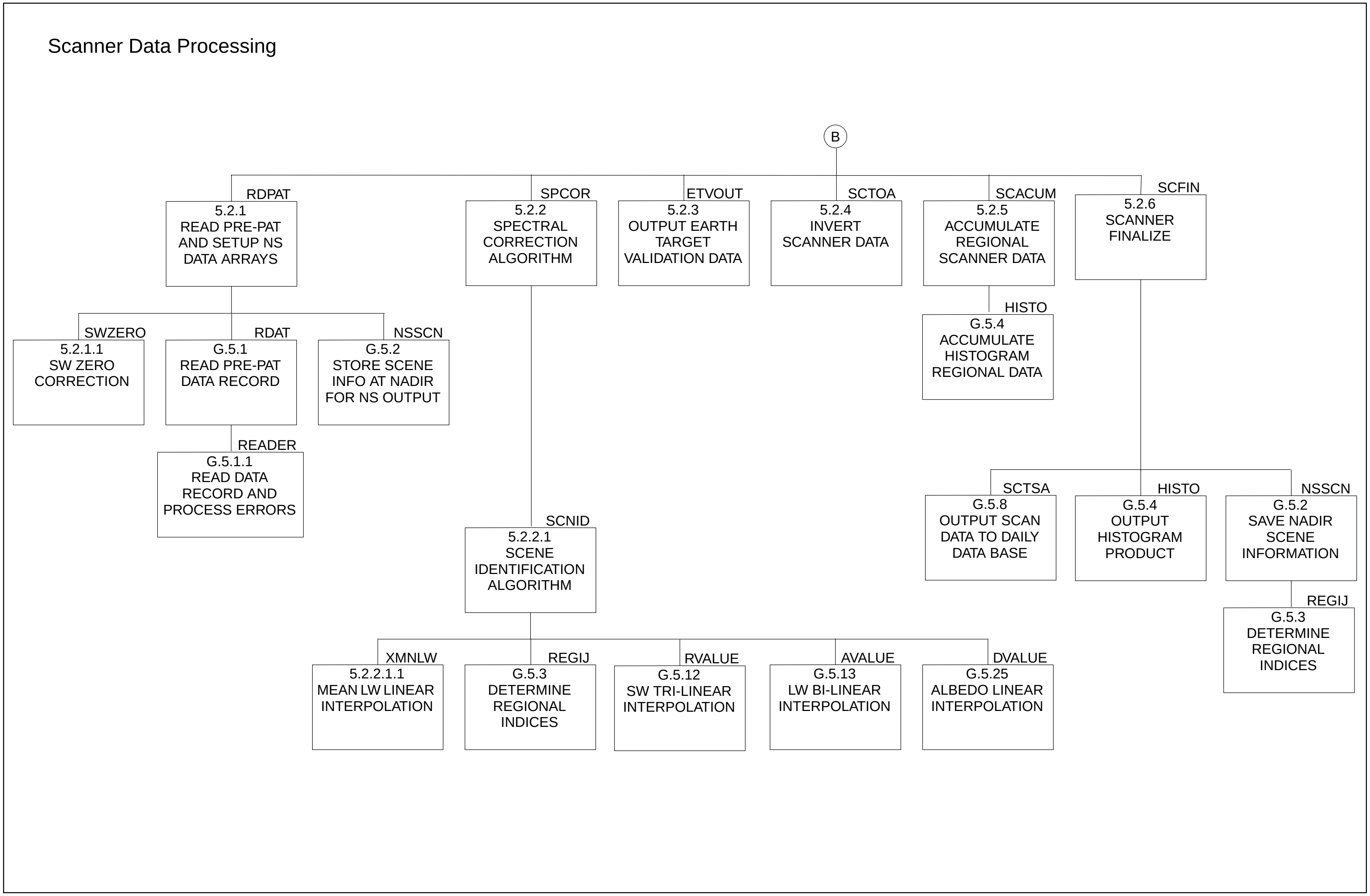


Figure 5.0-2. Inversion Subsystem Main-Processor Functional Structure Chart (3 of 6)

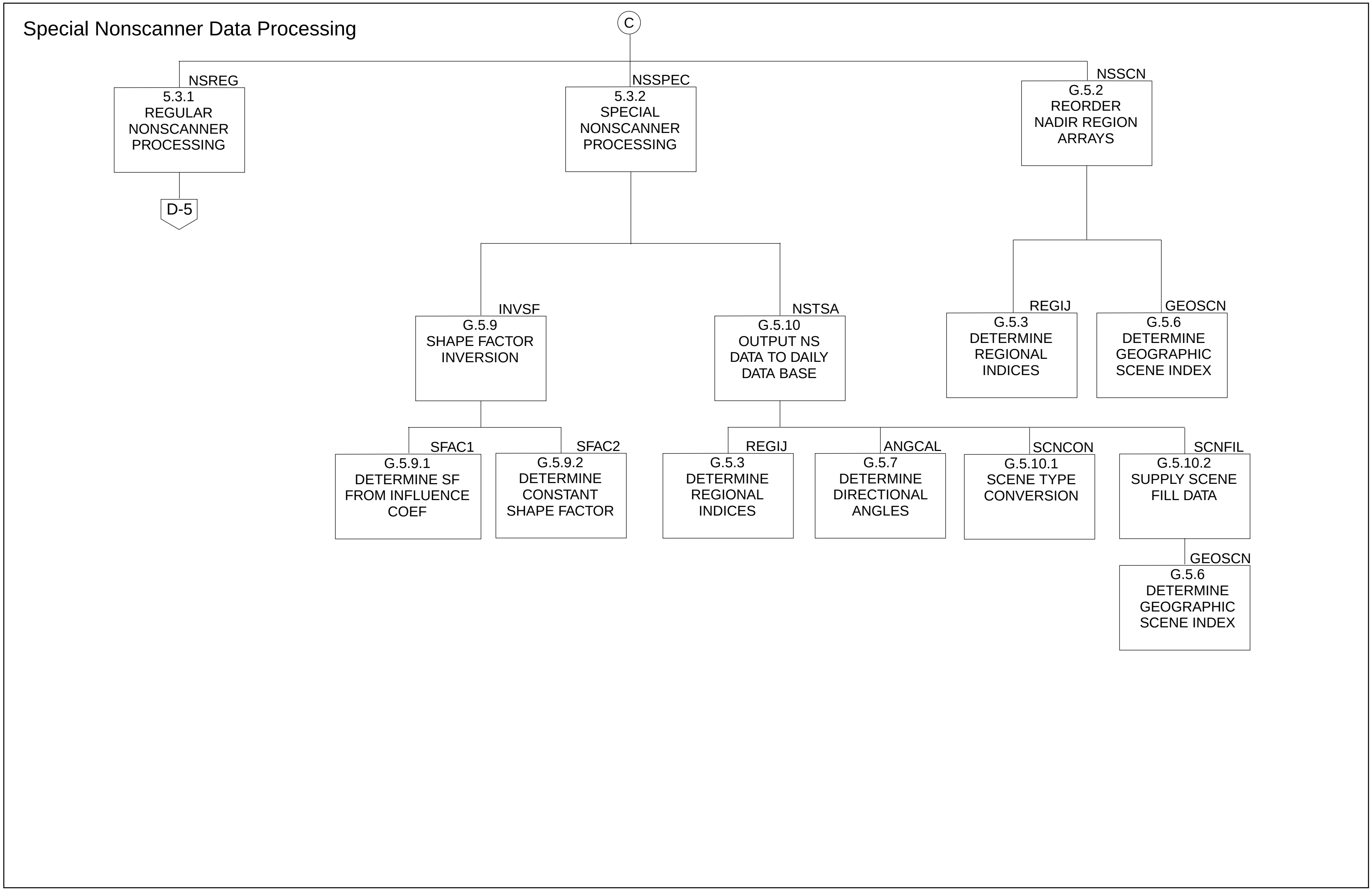


Figure 5.0-2. Inversion Subsystem Main-Processor Functional Structure Chart (4 of 6)

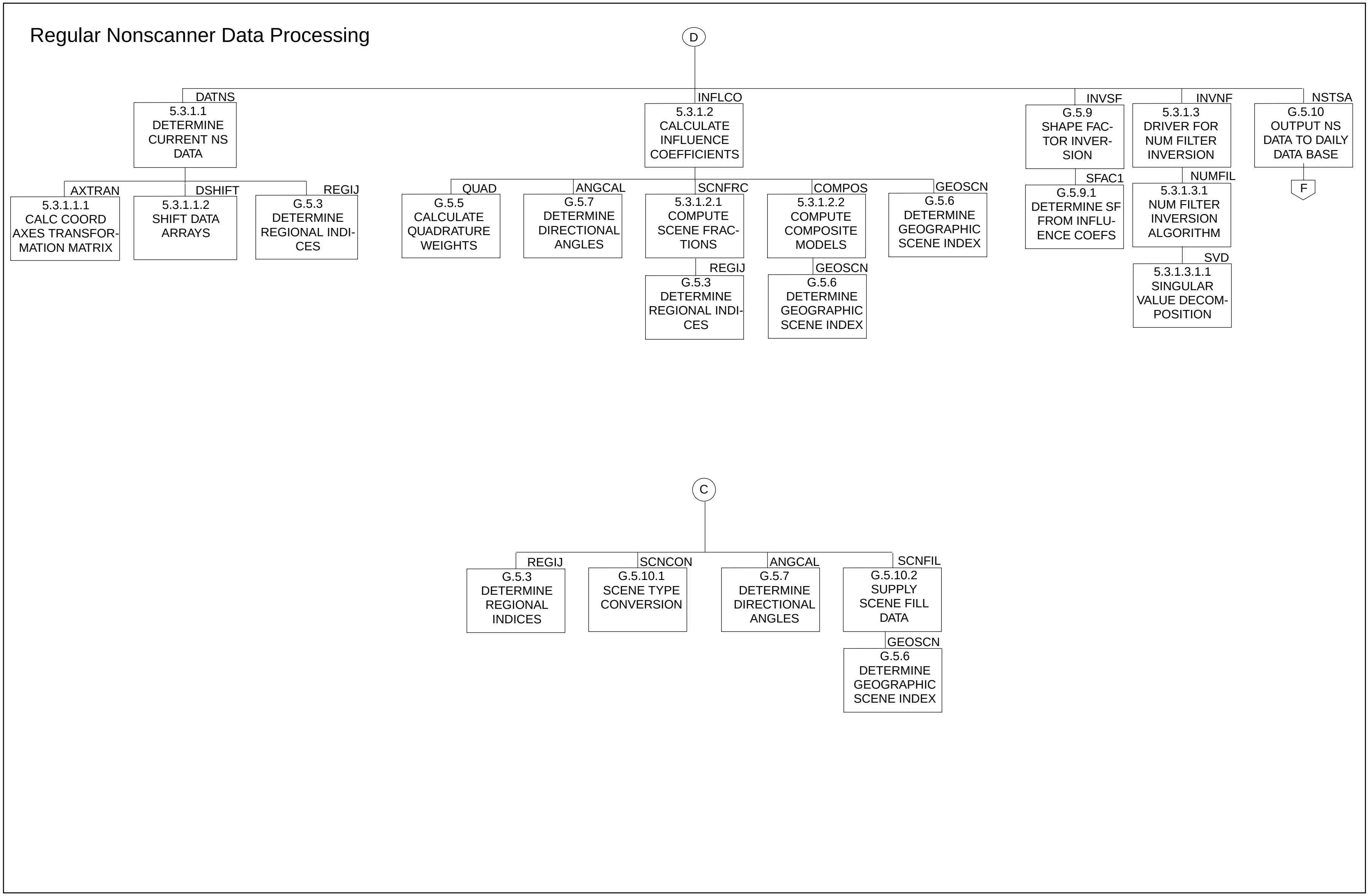


Figure 5.0-2. Inversion Subsystem Main-Processor Functional Structure Chart (5 of 6)

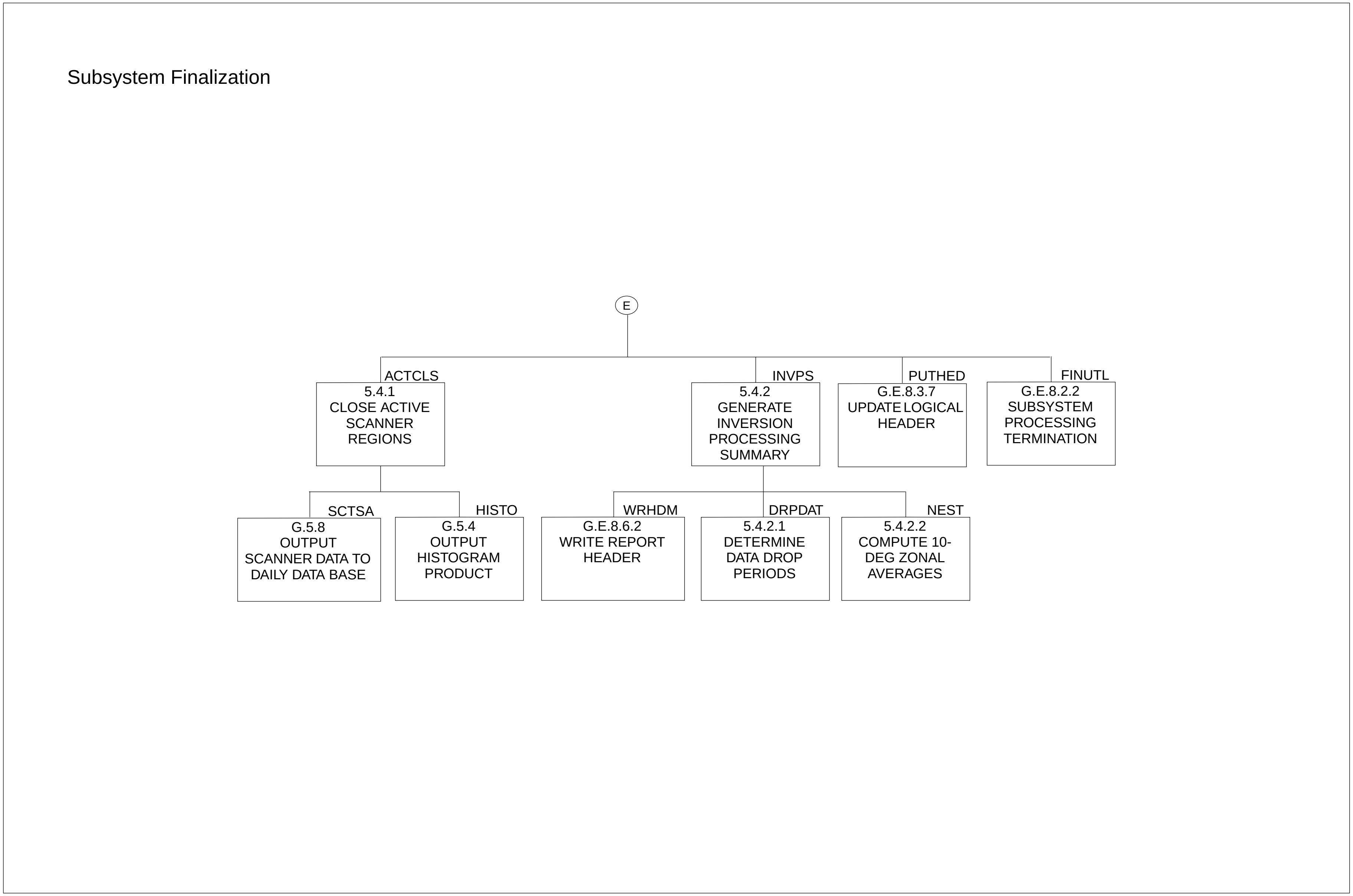


Figure 5.0-2. Inversion Subsystem Main-Processor Functional Structure Chart (6 of 6)

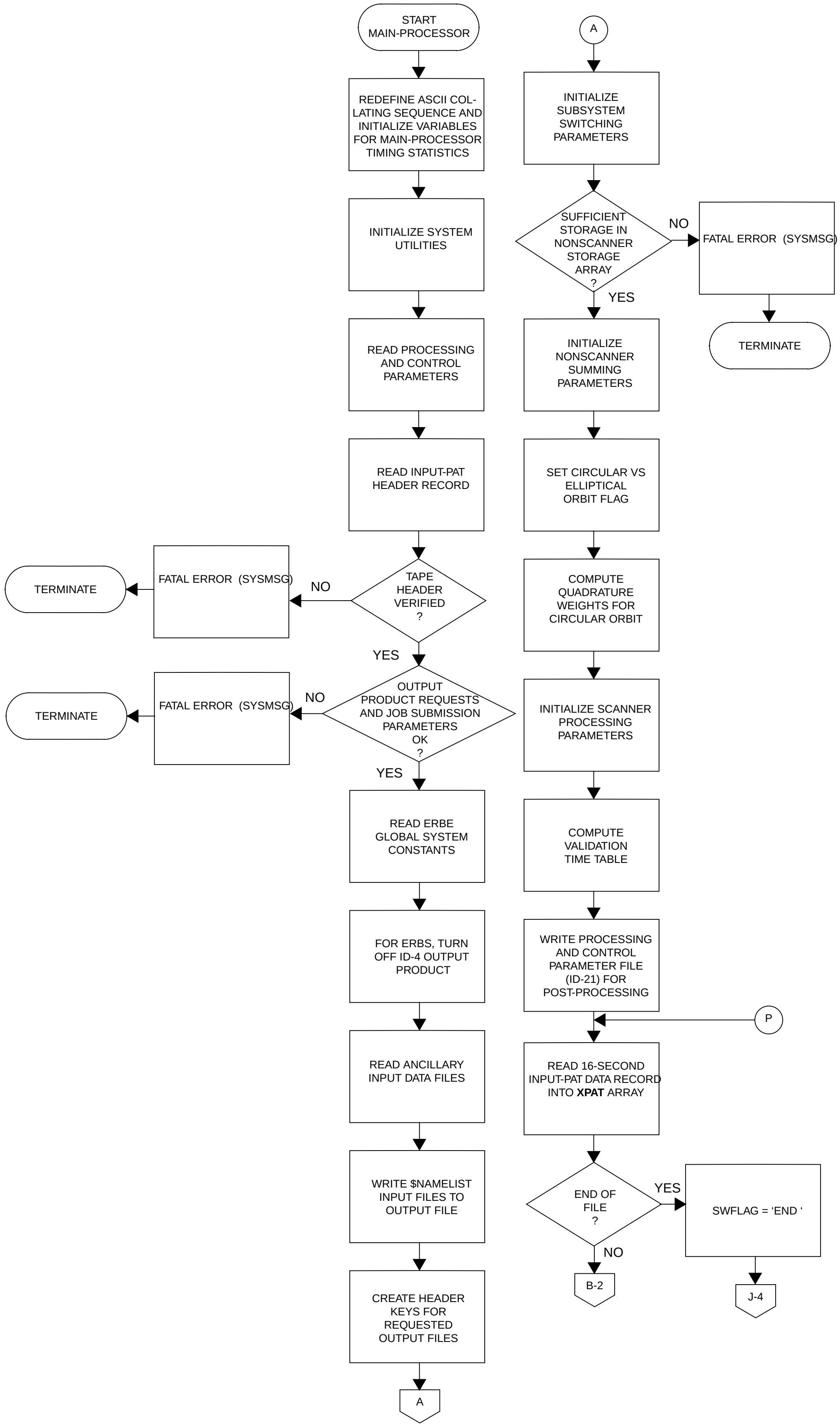


Figure 5.0-3. Inversion Subsystem Main-Processor Data Processing (1 of 6)

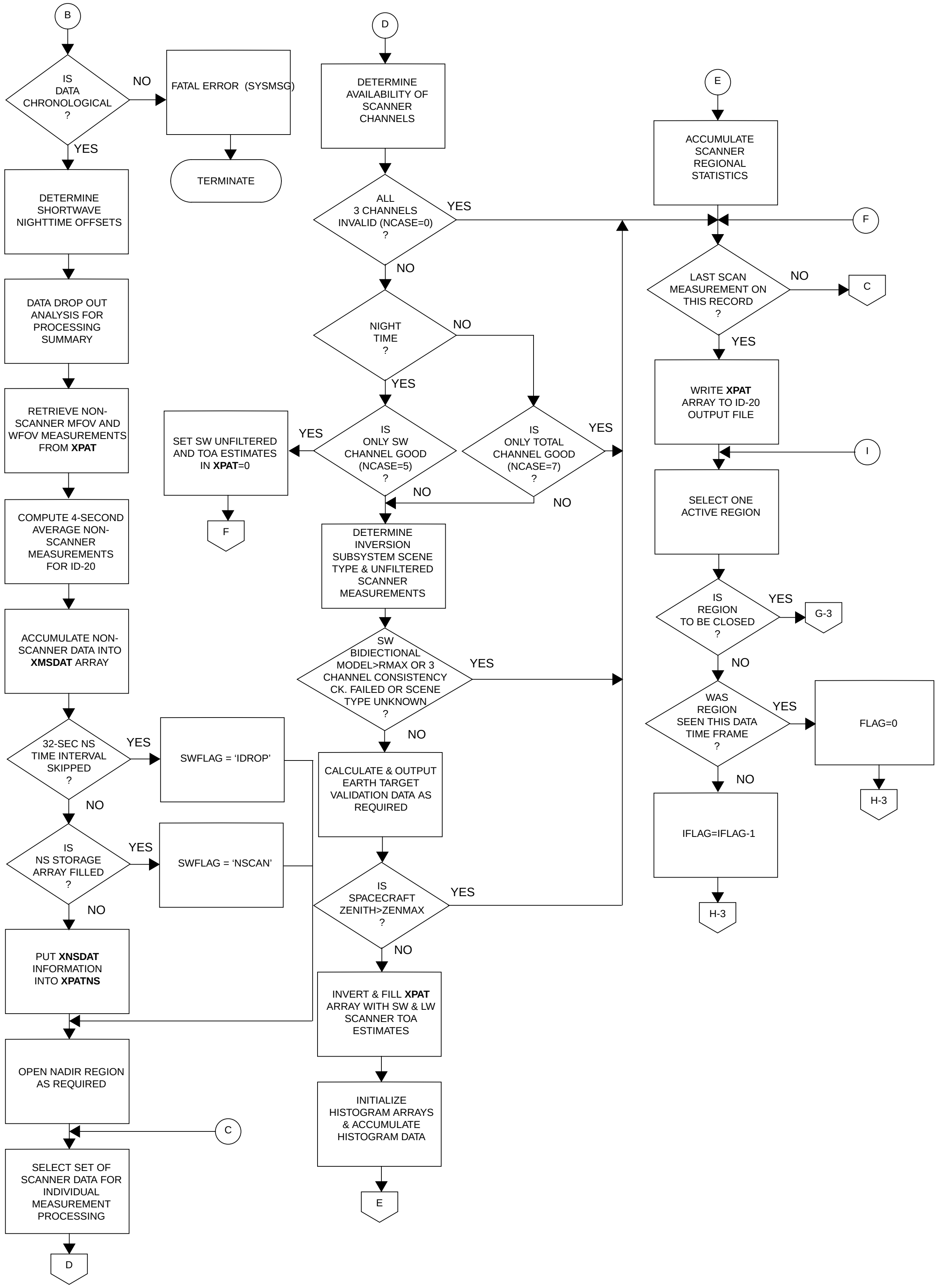


Figure 5.0-3. Inversion Subsystem Main-Processor Data Processing (2 of 6)

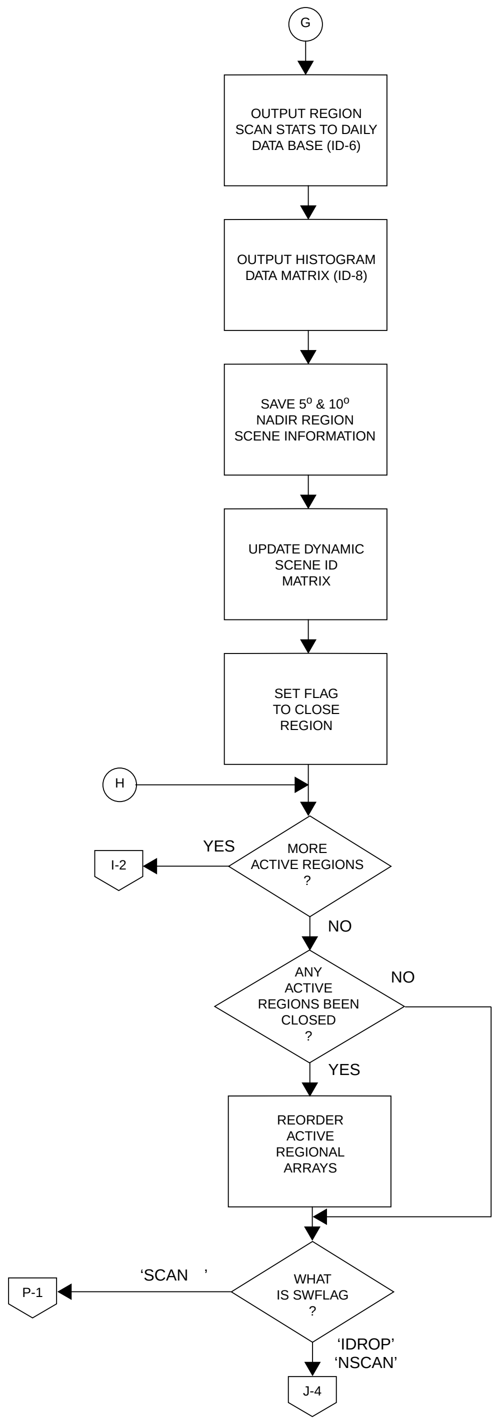


Figure 5.0-3. Inversion Subsystem Main-Processor Data Processing (3 of 6)

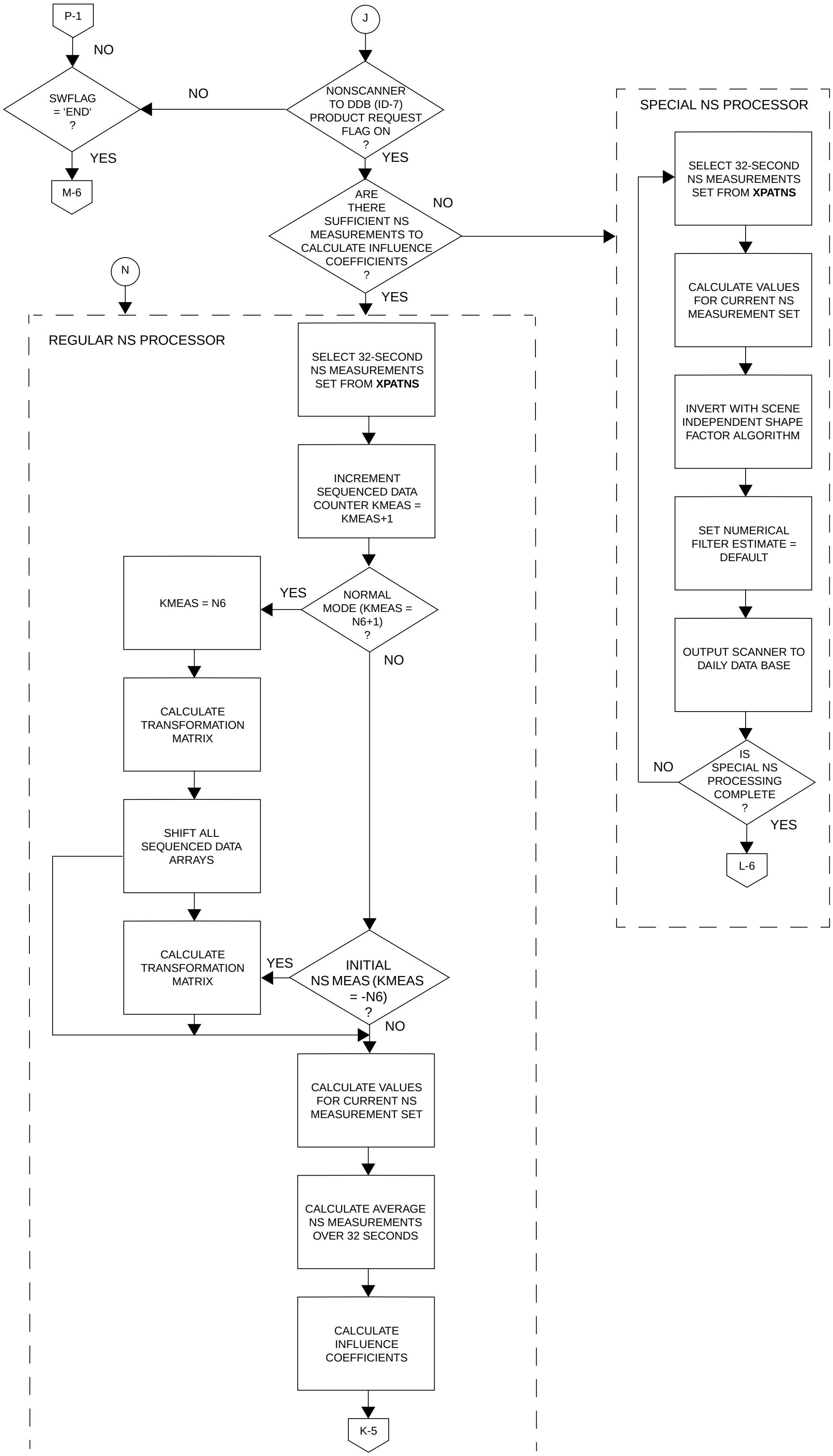


Figure 5.0-3. Inversion Subsystem Main-Processor Data Processing (4 of 6)

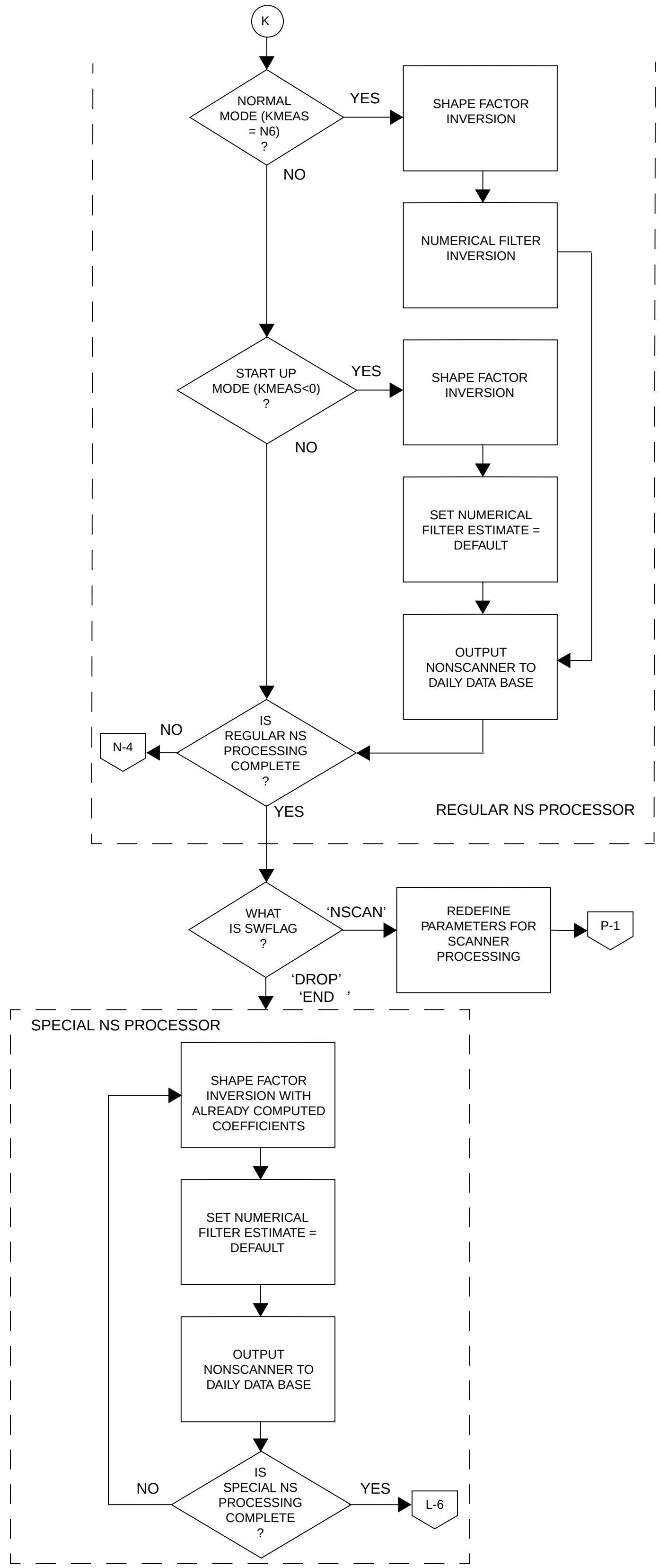


Figure 5.0-3. Inversion Subsystem Main-Processor Data Processing (5 of 6)

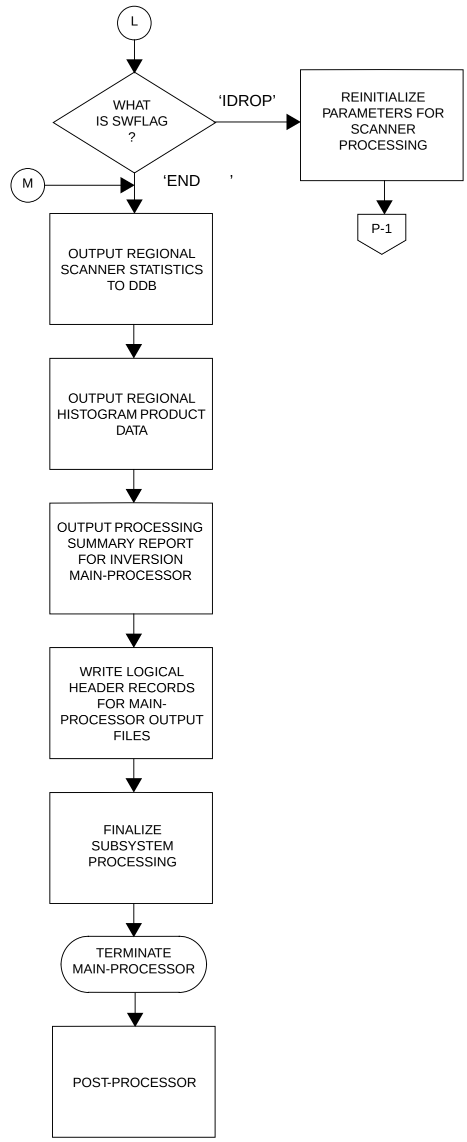


Figure 5.0-3. Inversion Subsystem Main-Processor Data Processing (6 of 6)

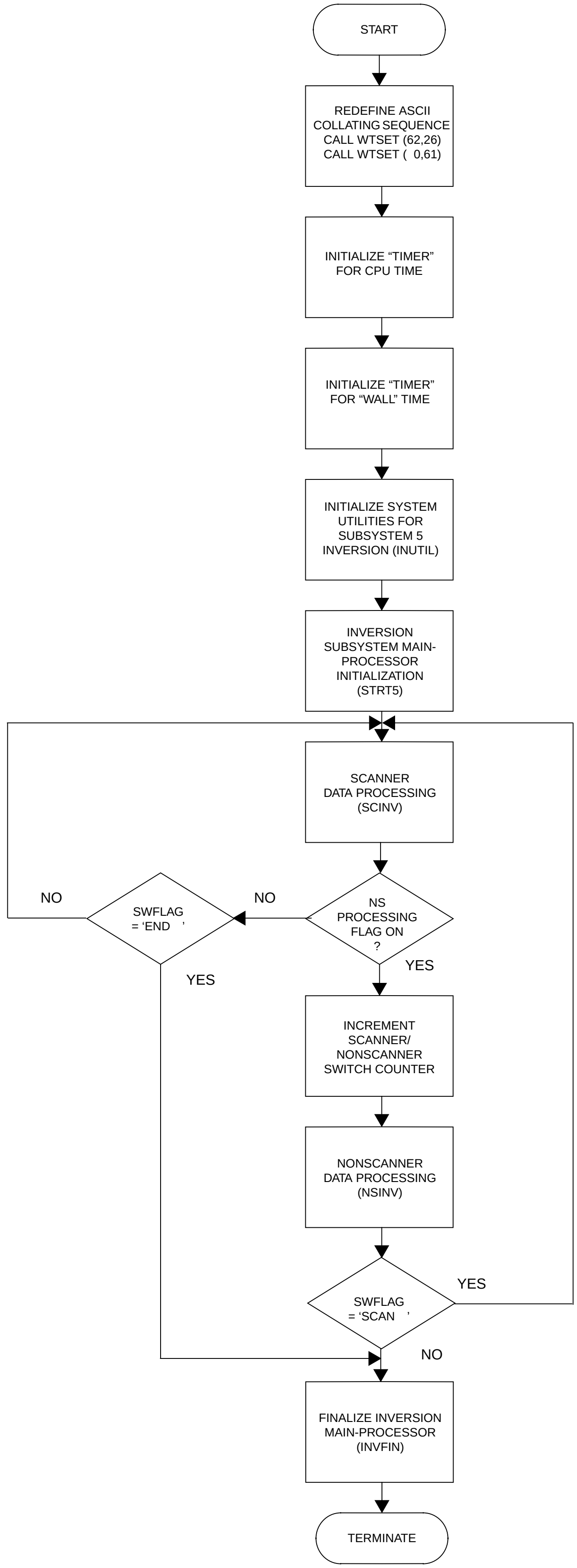


Figure 5.0-4. Flowchart of INVERT (Module 5.0)

Throughout this document the following conventions are adhered to concerning parameter descriptions.

SYMBOL	DESCRIPTION
$\hat{X}$	Estimate or unit vector
$\bar{X}$	Arithmetic mean
x	Scalar
x	Vector array, matrix or 2 or more dimensional array

5.1 INITIALIZATION (STRT5)

The purpose of subroutine STRT5 (Figure 5.1-1) is to prepare input and output files (see Appendices A and B) and to initialize parameters necessary for Inversion Subsystem processing. Specifically, these tasks include:

- Input and verify the appropriate data files required by the Main-Processor.
- Process and verify Inversion Subsystem output product requests.
- Verify data date and spacecraft code from keyboard entry at job submission against the logical header for the input-PAT.
- Create ERBE headers for output products.
- Initialize Inversion Subsystem processing parameters.
- Calculate the spacecraft's initial orbital elements.
- Generate the Scene Validation Data Time Table for the Post-Processor to use in preparing the ID-4 product.
- Echo all NAMELISTs to the ERBE output error message report file, MSGUNT (see COMMON Block /GLOBAL/).
- Prepare a file of processing and control parameters (ID-21) for the Post-Processor.

The first function of the Main-Processor initialization routine is to read the input file NIPCO2 which contains required processing and control parameters in the form of seven NAMELISTs (see Section A.6) and to verify the pre-PAT or PAT60 (collectively referred to as "input-PAT") header record (see subroutine PATVFY, #5.1.1).

A set of ERBE System processing constants is next read by STRT5. From these, several Inversion Subsystem constants are defined either to match existing variable names in the Inversion code or to convert to the physical units used by the Inversion Subsystem. Also, the files containing spectral correction algorithm parameters, scene identification algorithm parameters, quadrature weights, and scene independent shape factor coefficients are read into local storage. Once this is accomplished, all ancillary input data files are closed and deleted to free local file space. The data date (year, month, and day) and spacecraft code (1, NOAA 9; 2, ERBS; 3, NOAA 10) are then determined and are passed to subroutine CHKREQ (#5.1.4). CHKREQ processes data provided by

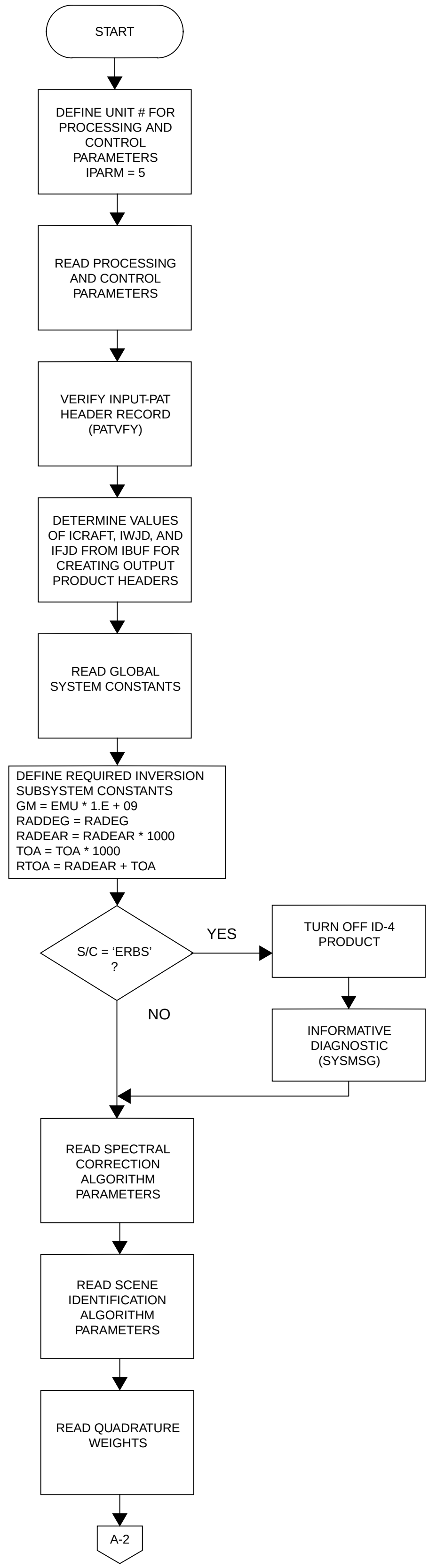


Figure 5.1-1. Flowchart of STRT5 (Module 5.1) (1 of 2)

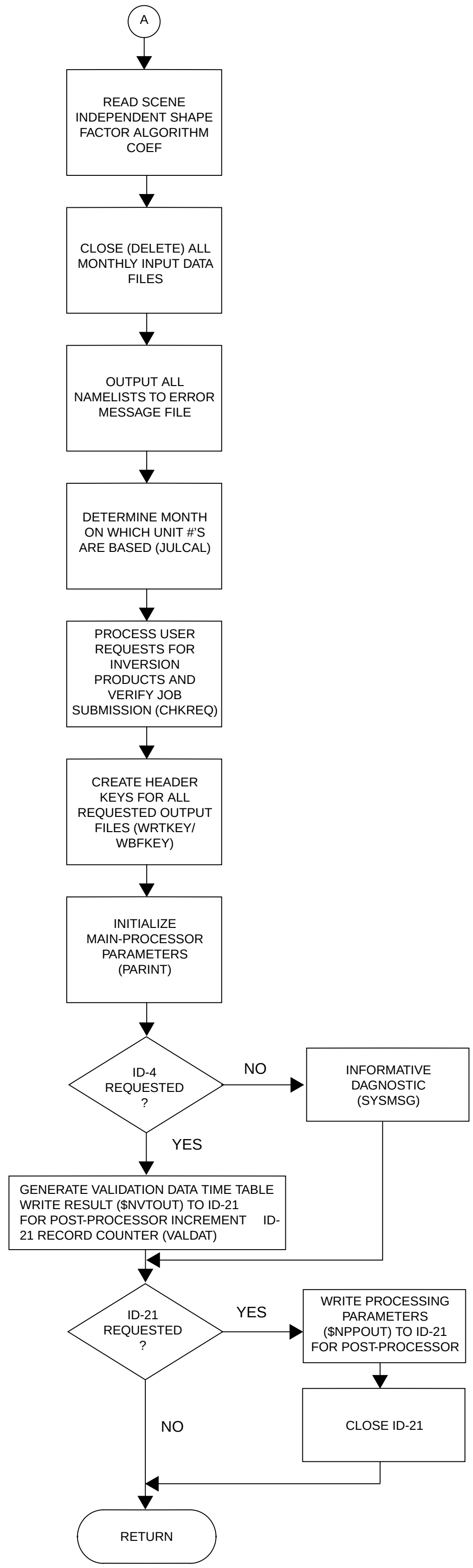


Figure 5.1-1. Flowchart of STRT5 (Module 5.1) (2 of 2)

the user during interactive job submittal. User supplied data date and spacecraft code are verified against these values derived from the input-PAT; a mismatch results in a fatal error. User output product requests are also processed in subroutine CHKREQ (see Sections B.1 and H.2). It should be noted that for the ERBS spacecraft the ID-4 output product is automatically turned-off by the software regardless of how the two ID-4 request flags are set.

Unit number values for ancillary input data files (see Section A.6) are contained on NAMELIST $NUNIT from file NIPC02. The Inversion Subsystem requires ancillary input data files which are dependent on data date and spacecraft and is designed so that the job submission software determines the appropriate file names based on the keyboard entry of data date and spacecraft code (see Appendix H).

System routines WRTKEY (#G.E.8.3.4) and WBFKEY (#G.E.8.3.20) are used to create ERBE product keys for all requested output products. Subsystem parameter initialization is performed in subroutine PARINT (#5.1.2). This process involves defining scanner/nonscanner switching parameters, determining the spacecraft orbital elements, and initializing scanner and nonscanner processing parameters and flags.

If the ID-4 (Scanner and Nonscanner Scene Validation Data Product) is requested, the Scene Validation Data Time Table is generated and passed to the Post-Processor on the ID-21 product (see subroutine VALDAT, #5.1.3). Also passed to the Post-Processor on the ID-21 product is the NAMELIST $NPPOUT which contains processing and control parameters which are common to both the Main-Processor and the Post-Processor.

5.1.1 HEADER RECORD VERIFICATION (PATVFY)

As a part of the Main-Processor initialization procedure, the ERBE header record of the primary input data tape must be verified to ensure that it is a valid input-PAT. To do this, ERBE System routine GBFHED (#G.E.8.3.19) retrieves the input-PAT physical header record (ERBE product key) and returns the logical header array, IBUF, from the logical header file. The first three digits of the 14-digit ERBE product key are determined from:

$$KEY = IBUF(1)/10^{**}11.$$

The input-PAT header record is then verified as shown in Figure 5.1-2.

It is important to note that there are two possible product keys that must be considered here:

a. Product key for pre-PAT (ID-3) as generated by the Merge-FOV Subsystem (KEY=402),

   and

b. Product key for PAT60 (ID-24) as generated by the Inversion Subsystem (KEY=514). The PAT60 may be encountered in the case of a restart (see Section A.2).

If the header is verified, the variable KEY is maintained in the /INTERN/ COMMON Block to be used later in subroutine READER (#G.5.1.1) to check for a “restart.”

If the header is not verified, processing is terminated and the appropriate fatal diagnostic is issued through subroutine SYSMSG (#G.E.8.4.1).

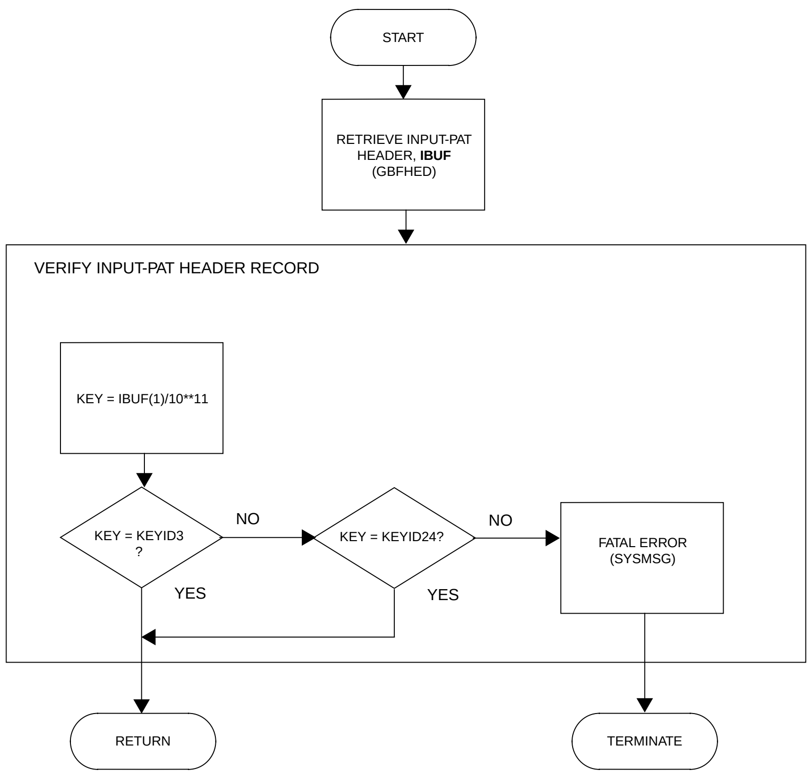


Figure 5.1-2. Flowchart of PATVFY (Module 5.1.1)

5.1.2 PARAMETER INITIALIZATION (PARINT)

The purpose of this subroutine is to initialize subsystem parameters as required for Inversion processing (see Figure 5.1-3). As a part of this initialization process, certain parameters that control the switching between scanner and nonscanner data processing are defined and checked. The switching logic between the two processing streams is a function of the user specified switching time (TPRD), the size of the nonscanner data storage array (**XPATNS**), and the minimum amount (NSMIN) of nonscanner data required to process data through the numerical filter algorithm. Elements of the switching logic are contained in program INVERT (#5.0) and in subroutines PARINT (#5.1.2), SCINV (#5.2), RDPAT (#5.2.1), NSINV (#5.3), and DATNS (#5.3.1.1).

Selected elements of the nonscanner data storage array, **XPATNS**, that are used to accumulate the sums of nonscanner measurements and the number of nonscanner measurements over 32-sec time intervals, are initialized to zero.

The initial position and velocity vectors of the spacecraft are retrieved from the first input-PAT record in subroutine RDATI (#5.1.2.1) from which the spacecraft initial orbital elements are calculated (see subroutine CARCON, #G.E.8.6.14). From this information it is determined whether the orbit is circular or elliptical, and a corresponding flag (ICIRC) is set. Based on the orbital eccentricity, e, and the semi-major axis, a, the altitudes above the TOA at apogee, h_a, and perigee, h_p, are calculated from

$$h_a = a(1 + e) - R_{TOA}$$

and

$$h_p = a(1 - e) - R_{TOA}$$

where R_{TOA} is contained in COMMON Block /CONST/ (see Table F-11).

If

$$h_a - h_p \le ORBCK,$$

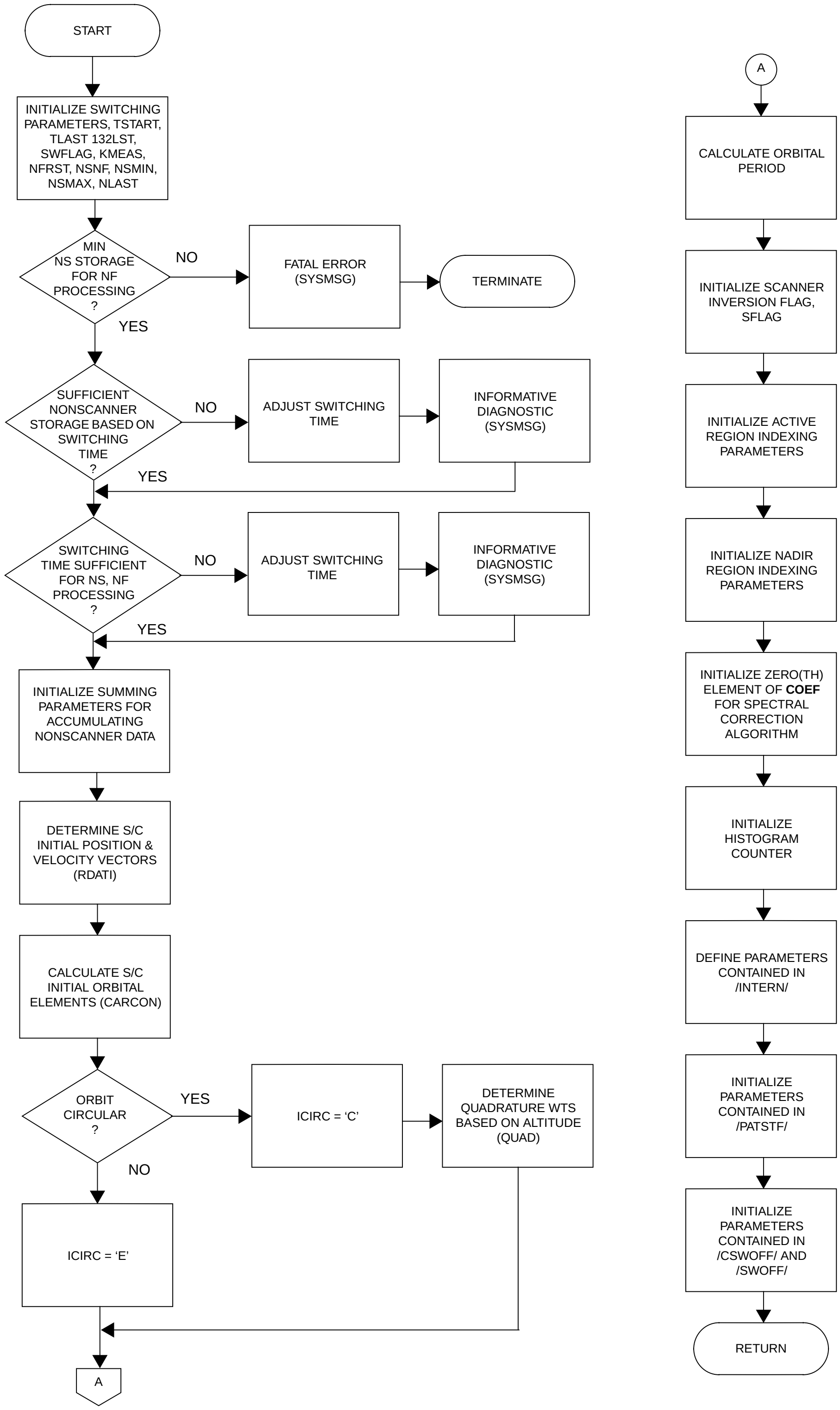


Figure 5.1-3. Flowchart of PARINT (Module 5.1.2)

the orbit is considered circular; otherwise, it is elliptical. ORBCK, nominally 30,000 m, is contained in COMMON Block /LIMITS/. If the orbit is circular, quadrature weights are computed once for both MFOV and WFOV by linear interpolation (see subroutine QUAD, #G.5.5). In the case of an elliptical orbit, quadrature weights are calculated every 32 seconds during nonscanner data processing (see subroutine INFLCO, #5.3.1.2).

Indices and parameters for active scanner regions, nadir regions, the spectral correction algorithm (**COEF** array), and the histogram product counter are initialized. In addition, several parameters contained in the /INTERN/ and /PATSTF/ COMMON Blocks are defined.

5.1.2.1 Initial Input-PAT Read (RDATI). Subroutine RDATI reads (BUFFER IN) the first input-PAT data record to acquire spacecraft position and velocity vectors from which the orbital elements will be calculated in subroutine PARINT (#5.1.2). The input-PAT is then backspaced by one record. Counters for the scanner and nonscanner record level flags, the number of input-PAT read attempts, and the number of successful reads are decremented as required to get values back to zero for subsequent data processing.

If an end-of-file is encountered during this initial read attempt, it is considered fatal since this should be the first data record on the input-PAT.

A flowchart of subroutine RDATI is shown in Figure 5.1-4.

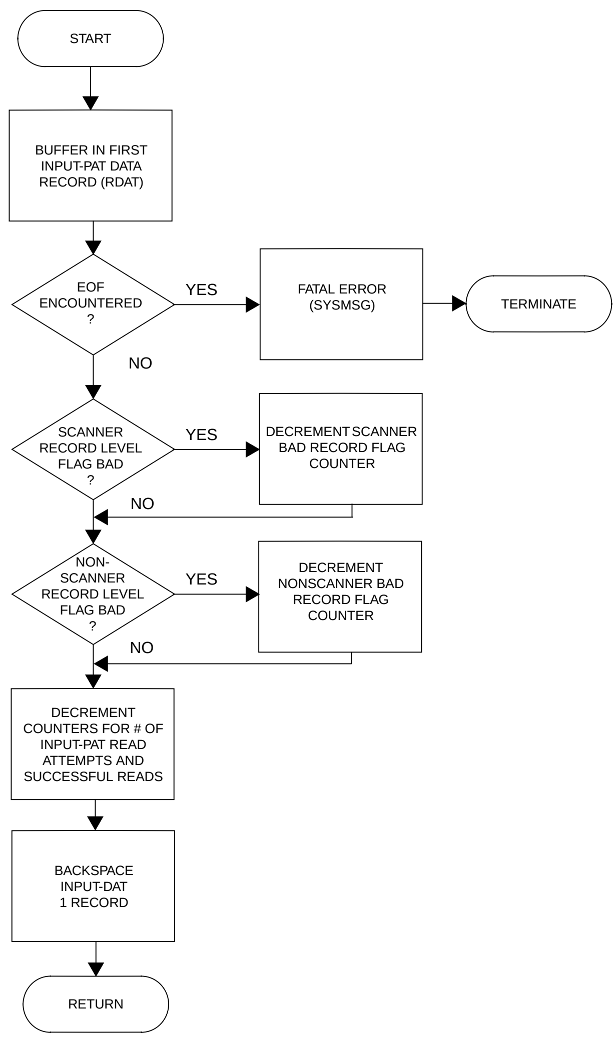


Figure 5.1-4. Flowchart of RDAT1 (Module 5.1.2.1)

5.1.3 VALIDATION DATA TIME TABLE (VALDAT)

The Scanner and Nonscanner Scene Validation Data (ID-4) contains PAT60 records for specified time intervals associated with designated validation regions. These validation regions are 5-deg regions that contain validation points defined by the ERBE Science Team. NAMELIST $NUSPAR (see Table A-8g) contains the colatitude (**VCOLAT**), longitude (**VLONG**), and the associated 5-deg region number (**NVREG**) for each validation point. $NUSPAR also contains the number of scene validation points (NVPTS) and the validation time period (VTP) as mentioned below.

The ID-4 is an output product of the Inversion Subsystem Post-Processor. However, the Main-Processor has the responsibility of generating the chronologically sorted Scene Validation Data Time Table which is passed to the Post-Processor in the **VDTIM** array (see Section B.8). This time table tells the Post-Processor (see Section 5.5.2) when to begin and stop dumping the **XPAT** array to the ID-4 product (see Section B.2) for particular validation regions. Since the spacecraft passes near the validation point on both the ascending and descending sides of the orbit, the **VDTIM** array actually contains two sets of start and stop times for each validation point along with the associated validation region number and a flag specifying either ascending or descending side of the orbit.

The Post-Processor begins data output for a given validation point at

$$t_{START} = t_{CA} - \Delta t/2$$

and ends data output at

$$t_{STOP} = t_{CA} + \Delta t/2$$

where t_{CA} is the Julian data at “closest approach” or when the spacecraft is “closest to” the validation point for either the ascending or descending side of the orbit, and Δt is the validation time period (VTP) over which validation data are required.

Scene validation data are output only every 5th day (parameterized as NVDAY). However, to provide program flexibility, the user specified parameter NVDAYO can be used to offset the frequency for which the ID-4 product is generated. On those days when this product is not required, the validation data output flag, IVOUT, is set to zero before it is passed to the Post-Processor through NAMELIST $NPPOUT on ID-21 (see Section B.8). Also, for the ERBS spacecraft, IVOUT is routinely set to zero in subroutine STRT5 (#5.1).

The processing algorithm for finding t_{CA} is described below for the validation point located at colatitude and longitude (θ_v, ϕ_v). Figure 5.1-5 shows an overview of the problem's geometry. At time t_0, the spacecraft is at position 1. The algorithm computes $\Delta\tau$ as the time required for the spacecraft to travel from position 1 to position 2, the point where the spacecraft will intersect the colatitude, θ_v, containing the validation point. Next, the "miss distance" or angular distance, $\Delta\lambda(t_v)$, between position 2 and position 3, the validation point, is determined. With this information the number of orbits the spacecraft will make between position 2 and position 4 is calculated as $IREV(t_v)$. Finally, the time of closest approach to the validation point is

$$t_{CA} = t_0 + \Delta t_1 + \Delta t_2$$

where

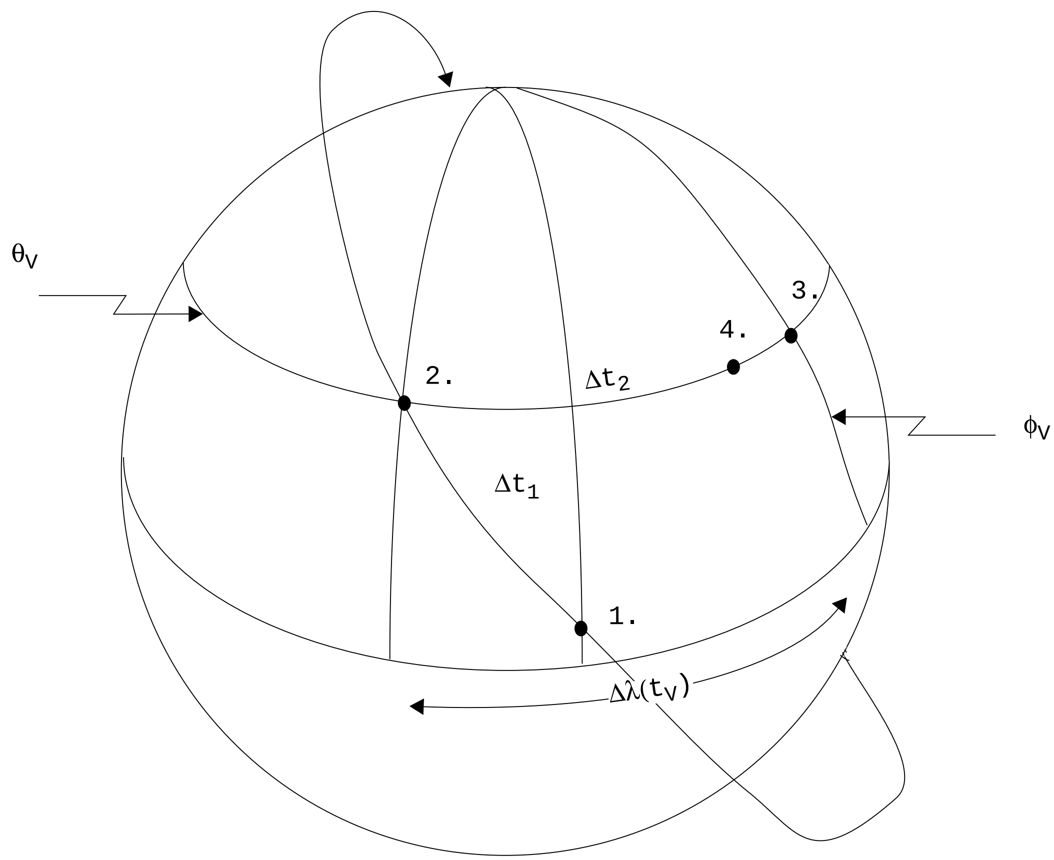
t_0 is the initial time in Julian days

$\Delta t_1 = \frac{\Delta\tau}{86400}$ is the time in days for the spacecraft to travel from position 1 to position 2

and

$\Delta t_2 = \frac{IREV(t_v) \times P}{86400}$ is the time in days required for the spacecraft to arrive at position 4 from position 2 (P is the orbital period in seconds).

More specifically, at t_0, the time of the first data time frame, the following orbital elements required in VALDAT are calculated in subroutine PARINT (#5.1.2).



1. Initial spacecraft position at time t_o.

2. Spacecraft position at intersection with colatitude of validation point at time t_v.

3. Position of validation point.

4. Spacecraft position at its closest approach to validation point at time t_{CA}.

Figure 5.1-5. Geometry for Determining the Time of Closest Approach to Validation Point

- True anomaly of the spacecraft, $f_{s/c}$
- Orbital eccentricity, e
- Orbital inclination, i
- Argument of perigee, ω
- "Longitude" of the ascending node, Ω_0

The orbital period, P, is input through NAMELIST $NSHPFA as PERID and is contained in COMMON Block /SHPFAC/ (see Table A-9). The semi-major axis is

$$a = \left[(GM)\left(\frac{P}{2\pi}\right)^2\right]^{1/3}$$

where GM is the Earth's gravitational constant. The nodal precession rate is calculated from (see Reference 2)

$$\dot{\Omega} = -\frac{3}{2a}\sqrt{\frac{GM}{a}}J_2\left(\frac{R_E}{p}\right)^2 \cos i$$

which can be rewritten in degrees/sec as

$$\dot{\Omega} = -\frac{3}{2}J_2\left(\frac{a^3}{GM}\right)^{-1/2}\left(\frac{R_E}{p}\right)^2 \cos i\left(\frac{180}{\pi}\right)$$

where

$p = a(1-e^2)$,

R_E is the radius of the Earth,

and

$\frac{3}{2}J_2$ is defined as 1.62329×10^{-3}

(see Reference 3).

The time required for the spacecraft to travel from perigee to the true anomaly, f, can be found from

$$\tau = \sqrt{\frac{a^3}{GM}}(E - e \sin E)$$

where E, the eccentric anomaly, is found from

$$E = \begin{cases} E' & , \text{ for } f \leq 180° \\ 2\pi - E, & \text{for } f > 180° \end{cases}'$$

and

$$E' = \cos^{-1}\left(\frac{e + \cos f}{1 + e \cos f}\right).$$

In this manner, the times required for the spacecraft to travel from perigee to $f_{s/c}$ and to f_v, the true anomaly of the spacecraft when it crosses the parallel of latitude at θ_v, are determined to be $\tau_{s/c}$ and τ_v, respectively.

Then the time for the spacecraft to travel from $f_{s/c}$ to f_v is

$$\Delta\tau = \begin{cases} \tau_v - \tau_{s/c} & , \text{ for } \tau_v \geq \tau_{s/c} \\ P + \tau_v - \tau_{s/c} & , \text{ for } \tau_v < \tau_{s/c} \end{cases}.$$

At time $t_v = t_0 + \Delta\tau$, the right ascension of the validation point is

$$\lambda_v(t_v) = \phi_v + \dot{\phi}\ \Delta\tau ,$$

where $\dot{\phi}$ is the Earth’s spin rate. For the spacecraft,

$$\lambda_{s/c}(t_v) = \Omega_o + \dot{\Omega}\Delta\tau + \beta$$

where for

$$b = \sin^{-1}\left(\frac{\cos i \ \cos\theta_V}{\sin i \ \sin\theta_V}\right)$$

$$\beta = b$$

for the ascending side of the orbit, and

$$\beta = 180° - b$$

for the descending side of the orbit.

The “miss distance” at time t_V is

$$\Delta\lambda(t_v) = \begin{cases} \lambda_v(t_v) - \lambda_{s/c}(t_v) & , \ \text{for } \lambda_v \geq \lambda_{s/c} \\ 360° + \lambda_v(t_v) - \lambda_{s/c}(t_v), & \text{for } \lambda_v < \lambda_{s/c} \end{cases} .$$

Now the number of revolutions the spacecraft will make while the validation point is moving along the parallel of latitude at θ_V over the angular distance, $\Delta\lambda(t_V)$, is

$$\text{IREV}(t_v) = \text{INTEGER}\left[\frac{\Delta\lambda(t_v)}{\Delta\dot{\lambda} \ P} + 0.5\right]$$

where

$$\Delta\dot{\lambda} = \dot{\phi} - \dot{\Omega} .$$

The time of closest approach in Julian days is then

$$t_{CA} = t_o + (\Delta\tau + IREV(t_v) \times P)/86400 \ .$$

A flowchart of subroutine VALDAT is shown in Figure 5.1-6.

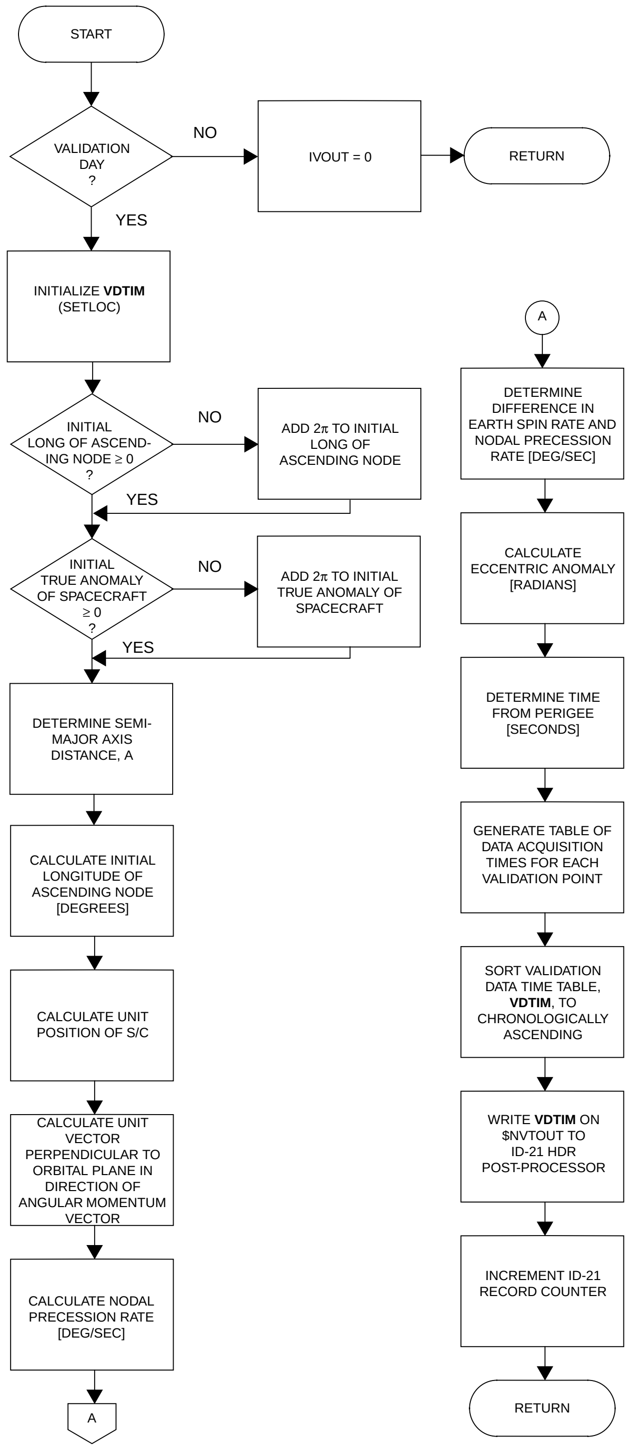


Figure 5.1-6. Flowchart of VALDAT (Module 5.1.3)

5.1.4 CHECK PRODUCT REQUESTS (CHKREQ)

Subroutine CHKREQ verifies that the requested input-PAT is being processed, and then reads a file of product requests and turns off all products not requested. For each optional Inversion Subsystem product, a character string is read from the input file. For requested products, the character string is equivalent to the file name or tape volume serial number (VSN) on which the product will reside. For products not requested, the associated string is equal to the character string NREQ. All products not selected are turned off by setting the associated unit numbers to zero. The flowchart of CHKREQ is shown in Figure 5.1-7.

Initially, CHKREQ compares the data date and spacecraft code, derived from the input-PAT, to comparable values derived from keyboard entry (see Section H.2). Values determined from keyboard entry are passed as parameters to procedure PINVSS which in turn defines parameters on the execution control statement of the Main-Processor. During execution of subroutine CHKREQ, these values are fetched by means of a call to the FTN5 supplied routine GETPARM and compared to the values derived from the input-PAT. If the data date and spacecraft code from the input-PAT do not match those derived from keyboard entry, program execution terminates by means of a call to SYSMSG (#G.E.8.4.1).

Once the input-PAT is verified, CHKREQ opens the product request file and reads the file contents into array REQSTS. Array REQSTS contains one entry for each optional Inversion Subsystem product. If an error or end-of-file is encountered during the read, SYSMSG is invoked to terminate processing. If the read is successful, the elements of REQSTS are processed sequentially. If the content of an array element is equal to NREQ, the unit number of the associated product is set to zero, and SYSMSG is invoked to issue an informative message. Once all elements of REQSTS are processed, control is returned to the calling routine.

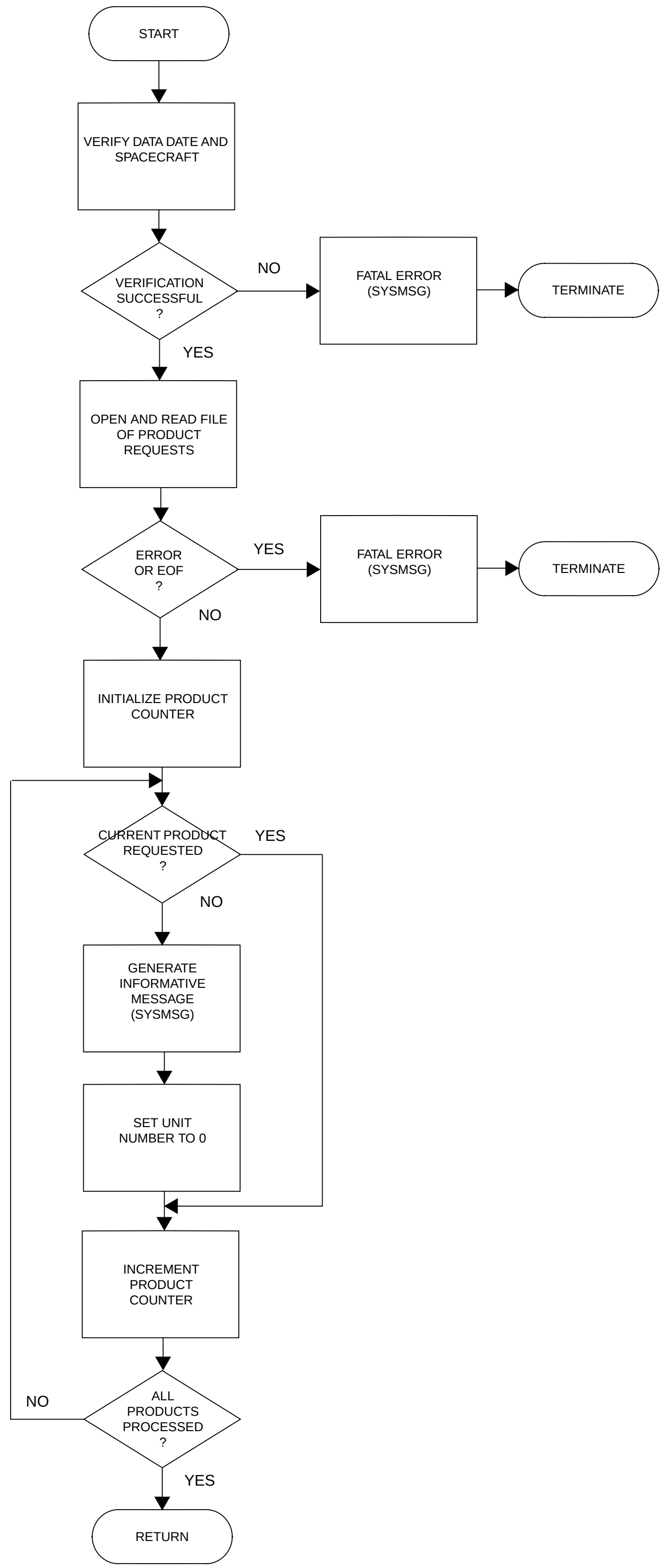


Figure 5.1-7. Flowchart of CHKREQ (Module 5.1.4)

5.2 SCANNER PROCESSING AND INVERSION (SCINV)

The scanner instrument operating in the Earth-viewing mode returns 74 samples per 4-sec cycle. These samples are obtained every 0.033 seconds. The spacecraft is oriented so that the scanner cycle starts away from the Sun and scans toward the Sun. There are 248 Earth-viewing samples or measurement sets per 16-sec data time frame (62 Earth-viewing samples per scanner cycle). Each scanner measurement set consists of total, shortwave, and longwave radiometric data, the position of the target point where the scanner FOV center line intersects the TOA, the spacecraft zenith angle, the solar zenith angle, and the relative azimuth angle.

During scanner data processing individual filtered radiometer measurements are unfiltered and inverted to radiant exitances at the TOA. Scene information is determined for each measurement set. The scene information and TOA estimates are averaged over 2.5-deg regions for a single orbital pass. The time interval over which these regional averages are calculated depends on the latitude of the target point and the inclination and velocity of the spacecraft, but the time interval will be on the order of one minute.

The 2.5-deg regional scene information is saved in the dynamic scene identification matrix for subsequent nonscanner data processing. More extensive scene information is saved for 5-deg and 10-deg nadir regions for subsequent nonscanner output.

The PAT* (ID-20) product is generated in this routine. In addition to the pre-PAT data, PAT* contains scanner and nonscanner unfiltered measurements and scanner TOA estimates and serves as an interface between the Main-Processor and the Post-Processor (see Section A.2). The nonscanner unfiltered measurements are determined in subroutine RDPAT (#5.2.1).

It is also determined in this subroutine whether the 2.5-deg region NREG is an Earth Target Validation Data region. If it is, certain scanner data are compiled into an array and written to a local file (see subroutine ETVOUT, #5.2.3).

Figure 5.2-1 illustrates the processing flow for subroutine SCINV.

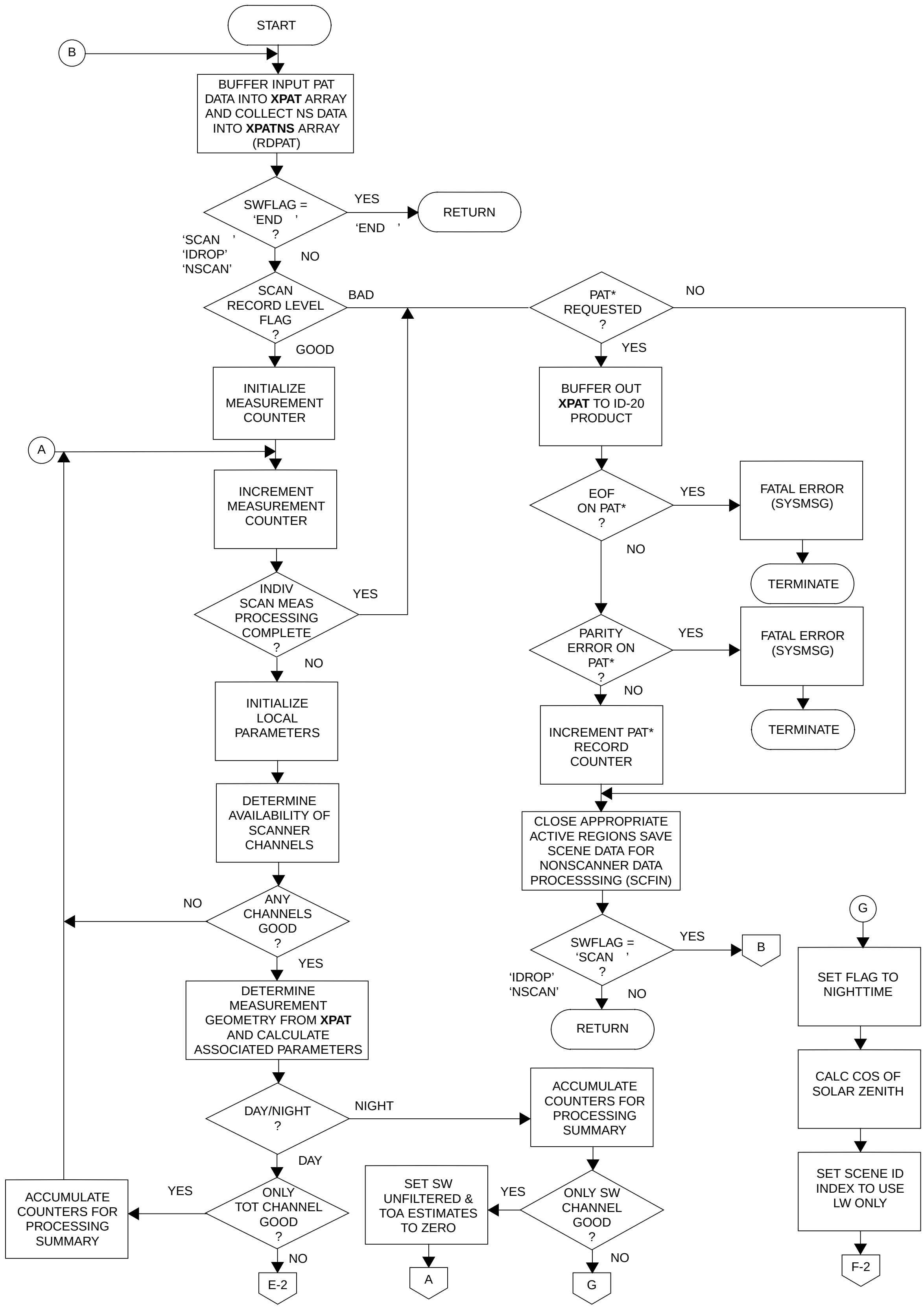


Figure 5.2-1. Flowchart of SCINV (Module 5.2) (1 of 2)

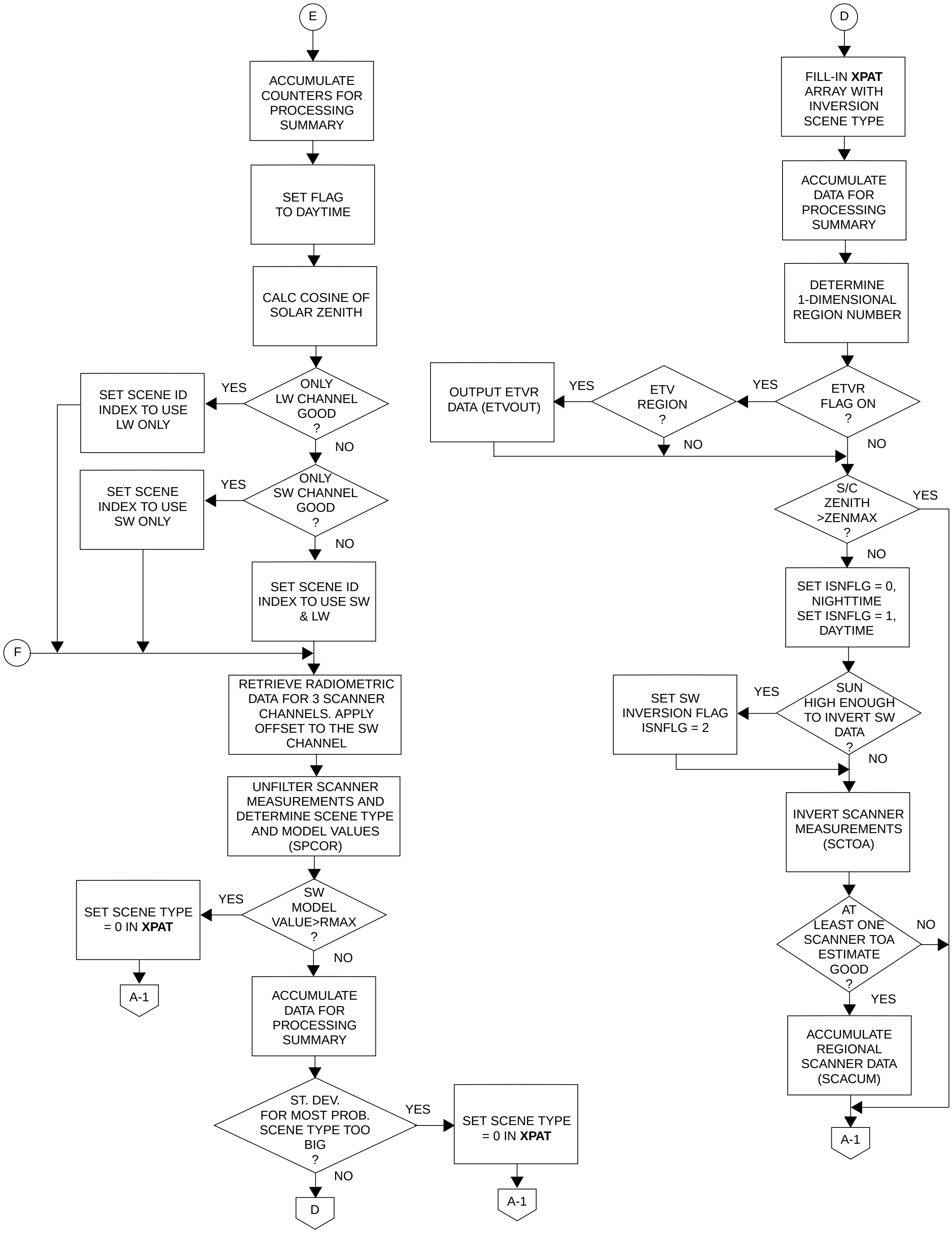


Figure 5.2-1. Flowchart of SCINV (Module 5.2) (2 of 2)

Several items concerning this processing flow are elaborated on below.

- The techniques used to determine the availability of scanner channels are illustrated in Figure 5.2-2. As shown, IVAL is a counter for the number of valid scanner channels per measurement set. ISUM accumulates the sum of the valid channel indices (SW=1, LW=2, and TOTAL=3). The variable ITEST is used as an index into the **IPROD** array from which the value of NCASE is determined. The possible results are shown in Table 5.2-1.

- Table A-4 shows the twelve possible scene types as determined by the Inversion Subsystem scene identification algorithm (subroutine SCNID, #5.2.2.1). In addition, a value of zero may be written to the PAT* product if subroutine SCINV determines that the scene type is unknown. Two results from subroutine SCNID can cause this.

  (1) The shortwave bidirectional model value is greater than RMAX (see COMMON Block /LIMITS/, Table A-8c).

  (2) The standard deviation for the most probable scene type is greater than SIGMAX (see COMMON Block /LIMITS/).

- It should be noted that subroutine SCNID is called by subroutine SPCOR (#5.2.2), the spectral correction algorithm, and not directly from subroutine SCINV.

- The character flag, SWFLAG, is fundamental to the scanner/ nonscanner switching logic. Table 5.2-2 describes this flag.

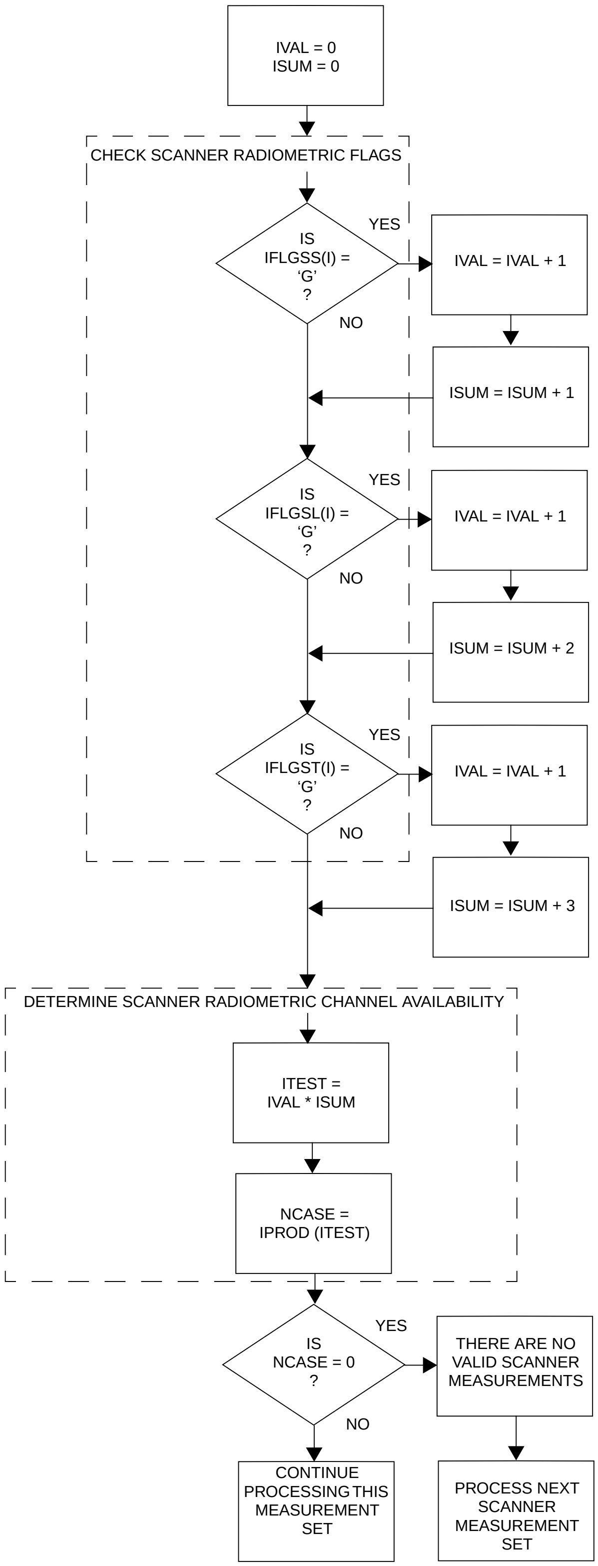


Figure 5.2-2. Logic for Determining Availability of Scanner Channels

Table 5.2-1. Determination of Scanner Channel Availability

NCASE	AVAILABLE CHANNELS	IVAL	ISUM	ITEST = IVAL*ISUM
0	NONE	0	0	0
1	SW, LW, TOT	3	6	18
2	SW, LW	2	3	6
3	SW, TOT	2	4	8
4	LW, TOT	2	5	10
5	SW	1	1	1
6	LW	1	2	2
7	TOT	1	3	3

Table 5.2-2. Description of the SWFLAG Parameter

SITUATION	SWGLAG VALUE	ACTION TAKEN
XPATNS array filled	‘NSCAN’	Complete scanner processing of current data time frame, then go to nonscanner processing
Missing one or more 32-sec nonscanner time intervals	‘IDROP’	
End-of-file encountered on input-PAT	‘END ’	Go to nonscanner data processing
Routine pass through scanner processing	‘SCAN ’	Continue scanner processing
NOTES: 1. SWFLAG is initially set to ‘SCAN’ in subroutine PARINT, #5.1.2		

5.2.1 READ INPUT-PAT (RDPAT)

Subroutine RDPAT performs the following functions.

- Read input-PAT (subroutine RDAT, #G.5.1).

- Terminate processing if data records are not in chronologically increasing order (subroutine SYSMSG, #G.E.8.4.1).

- Determine offsets to correct daytime shortwave filtered measurements (subroutine SWZERO, #5.2.1.1).

- Determine when to switch from scanner to nonscanner processing due to either

  - encountering an end-of-file (SWGLAG = ‘END’)

  - 32-sec nonscanner data interval missing (SWFLAG = ‘IDROP’)

  - nonscanner data storage array filled (SWFLAG = ‘NSCAN’).

- Determine whether Nonscanner output to the Daily Data Base Subsystem (nonscanner to DDB, ID-7) is requested. Note that no request for the ID-7 results in no TOA nonscanner data going to the PAT60 product.

- Calculate 4-sec nonscanner unfiltered measurements to go onto the PAT* product.

- Accumulate nonscanner unfiltered data over 32 seconds and store these data for later processing.

- Generate and continuously update array documenting the five largest physically missing time intervals from the input-PAT.

- Initialize nadir regions (subroutine NSSCN, #G.5.2).

Figure 5.2-3 describes RDPAT processing. A more detailed discussion of certain aspects of RDPAT follows.

The first step in the scanner processing flow is to buffer in a 16-sec record or data time frame from the input-PAT. If an end-of-file is encountered, the switching flag (see Table 5.2-2) is set accordingly and nonscanner processing is initiated. In the case of a normal read, the input-PAT record is stored in the vector array **XPAT** containing 3630 words which will be used for scanner and nonscanner data processing. This array is in the COMMON Block /PATSET/ and is shown in Table F-30. In addition, seven character arrays, three dimensioned by 248 each for scanner measurements and four dimensioned by 20 each for nonscanner measurements, contain flags, which are set good or bad, combining radiometric and FOV status (see the /FLAG/ COMMON Block, Table F-15). Subroutine RDAT (#G.5.1), which is invoked from RDPAT, is the module responsible for buffering in the input-PAT records and setting the subsystem’s measurement level flags.

The time at the beginning of the current data time frame is compared to the beginning time from the previous data time frame. The time must be chronologically increasing for data processing to continue.

A check is made for missing 16-sec records. If one or more records are missing, a data dropout counter is incremented. Furthermore, subroutine RDPAT continuously updates the array **BLKOUT**. This array maintains a record of the start and stop time (minutes), colatitude (degrees), and longitude (degrees) for each of the five longest data dropout periods. This information and the data dropout counter are stored in COMMON Block /REPORT/ for the Main-Processor Processing Summary (see Section B.10).

The rest of this subroutine deals with preliminary processing of nonscanner data. This processing is skipped if either the nonscanner record level flag is bad or if the nonscanner to DDB (ID-7) is turned off.

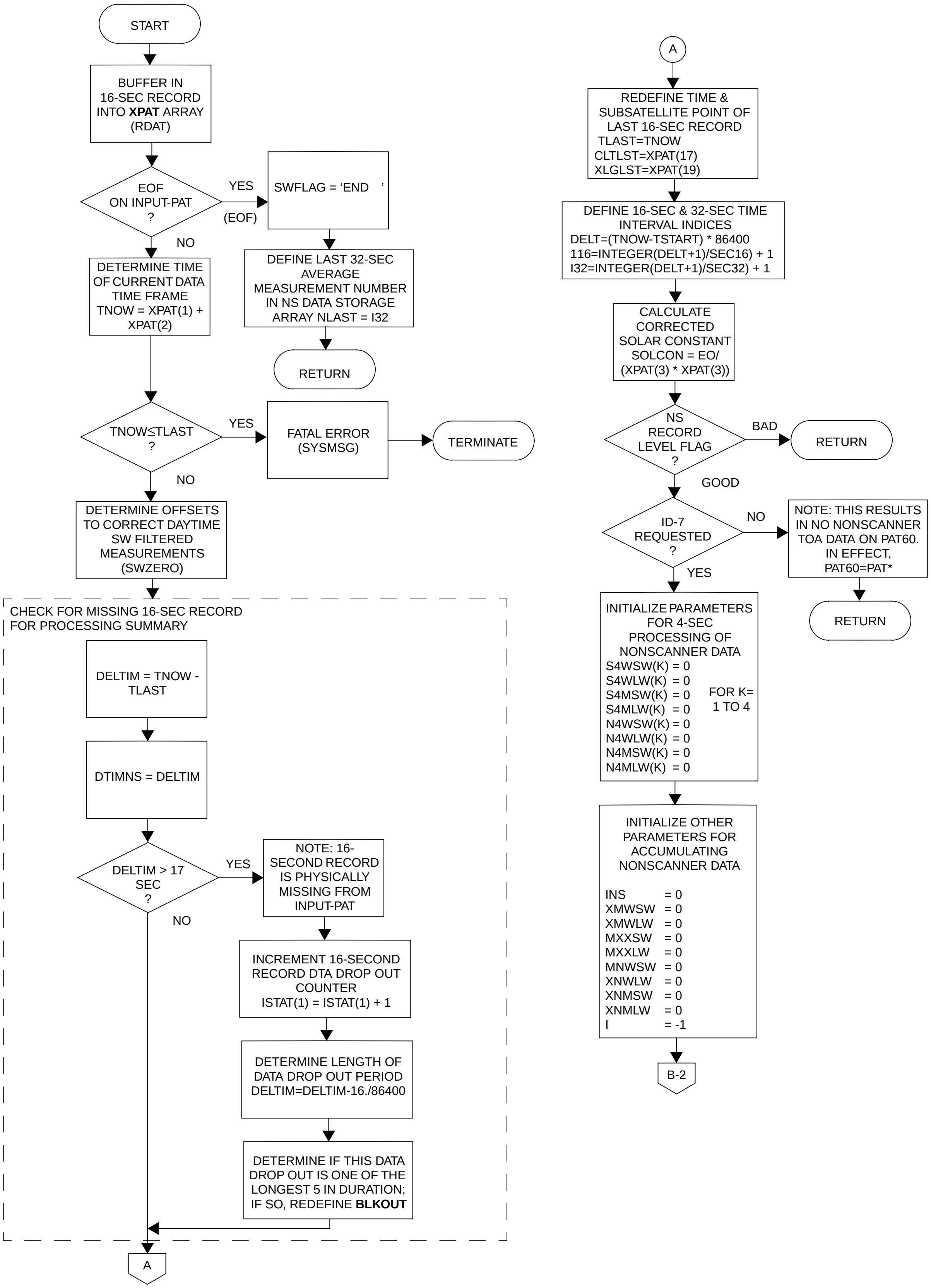


Figure 5.2-3. Flowchart of RDPAT (Module 5.2.1) (1 of 3)

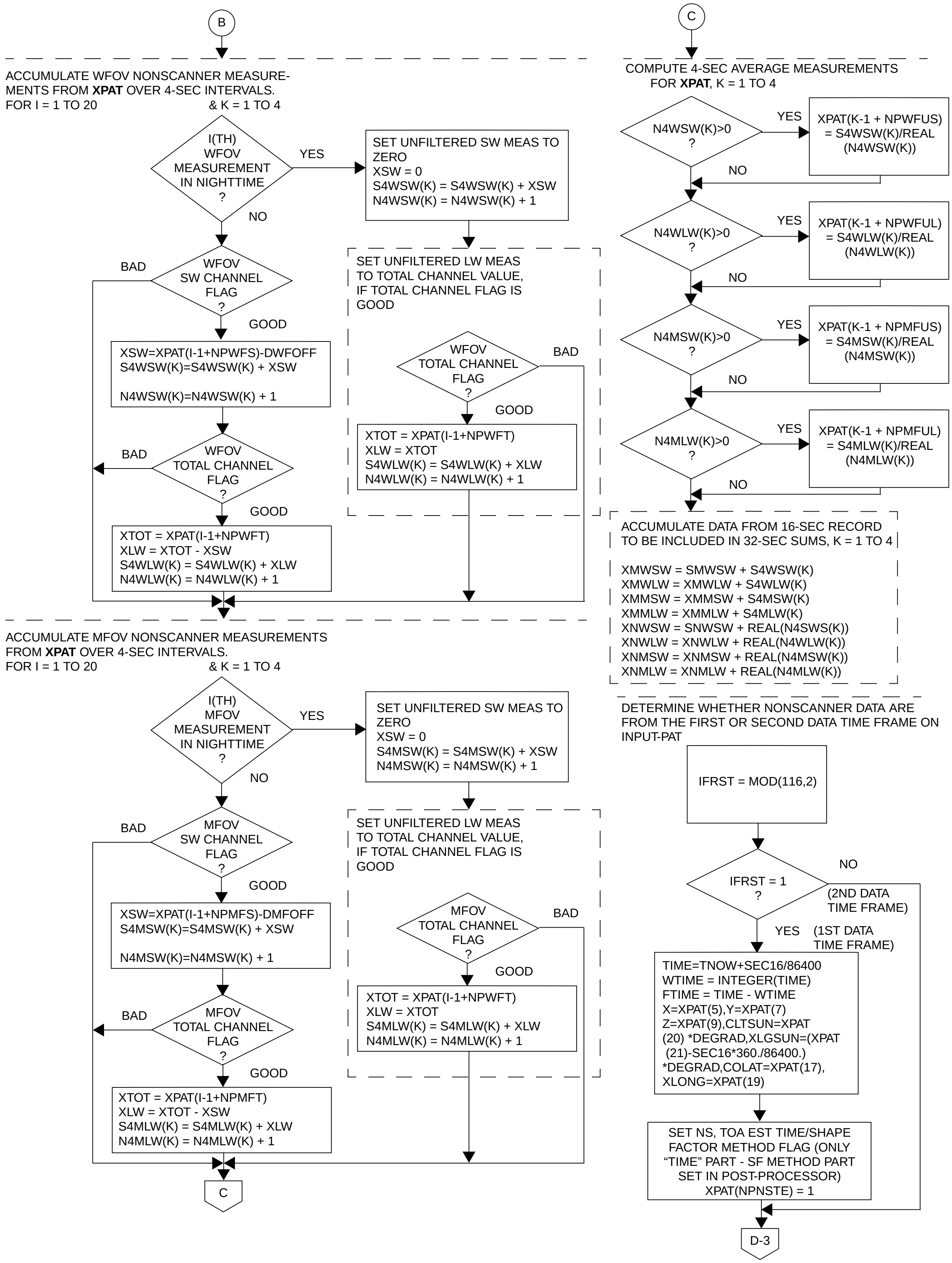


Figure 5.2-3. Flowchart of RDPAT (Module 5.2.1) (2 of 3)

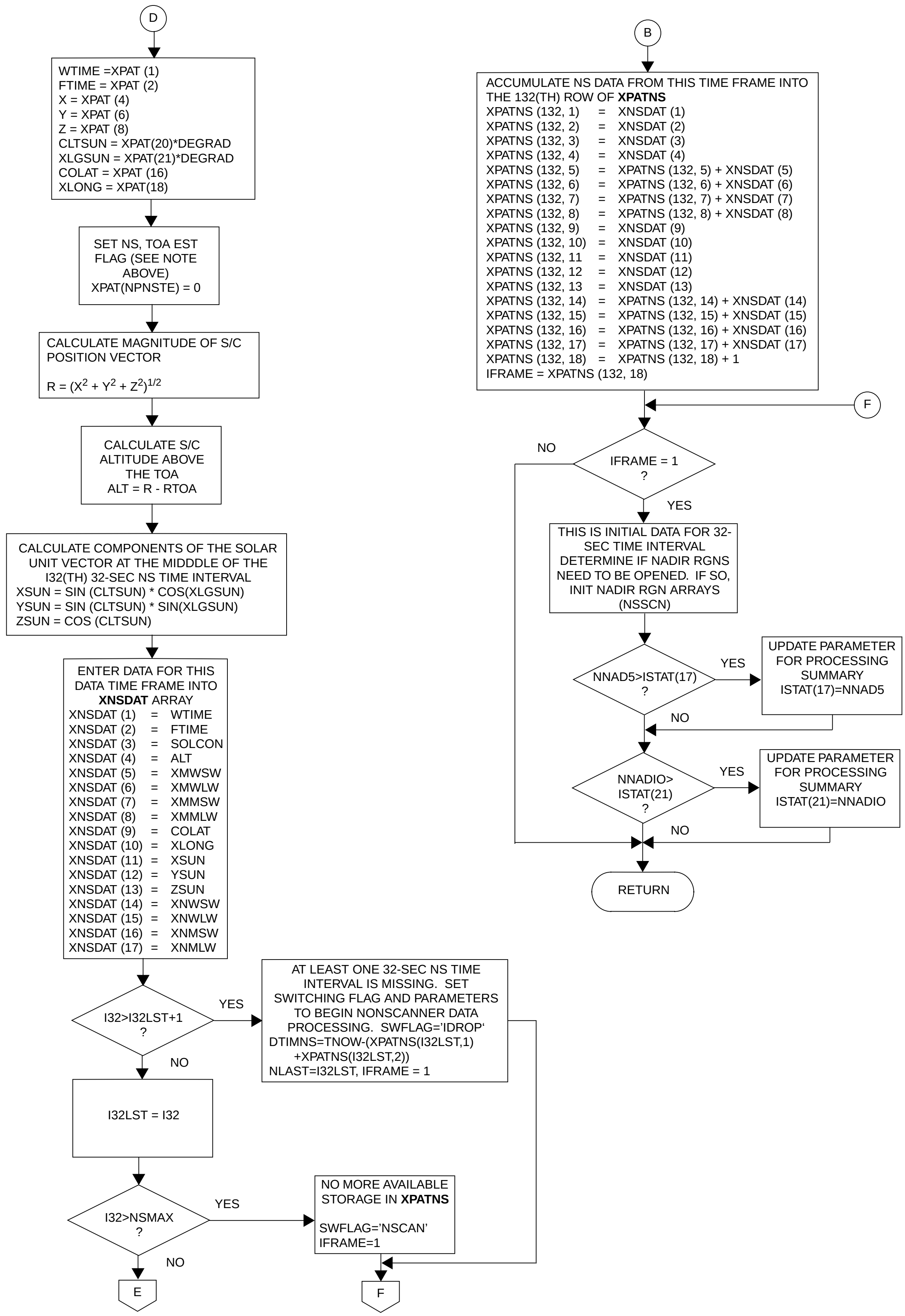


Figure 5.2-3. Flowchart of RDPAT (Module 5.2.1) (3 of 3)

NOTE: If the ID-7 product is not requested, there will be NO nonscanner TOA estimates on the PAT60 or subsequent products. This includes flags set by the Inversion Subsystem that concern TOA estimates of nonscanner data.

If the Post-Processor determines there is no ID-7 product, the PAT* data is copied from local file directly to the PAT60 product (see subroutine PATBUF, #G.5.15).

This system forces the user to request the ID-7 product if nonscanner TOA data is desired on the PAT60. The motivation for this is to ensure the Post-Processor's restart capability, which requires both a PAT* (or PAT60) and an ID-7. The daily Medium-Wide FOV Data Tape (ID-12), another nonscanner data product from the Post-Processor, also requires the ID-7.

There are 20 nonscanner measurement sets per 16-sec input-PAT record. Each of these measurement sets contains radiometric data for MFOV and WFOV from a shortwave channel and a total channel. Also included are the colatitude and longitude of the center of the FOV. If the nonscanner record level flag is good and the ID-7 request is on, the nonscanner 4-sec unfiltered measurements are calculated. The unfiltering algorithm is implemented for the WFOV data and the MFOV data separately and is detailed in the flowchart for this module. Resulting values are placed into the **XPAT** array (PAT* product) here rather than in the Post-Processor. Also, if no unfiltered measurement is calculated, the Subsystem default value fills that element in the **XPAT** array.

NOTE: Recall that the Merge-FOV Subsystem fills all elements of the **XPAT** array for which the Inversion Subsystem is responsible with the default value, XERROR (see COMMON Block /USPARM/).

These 4-sec unfiltered nonscanner measurements are accumulated over 16 seconds and stored with other data required for nonscanner processing in the **XNSDAT** array.

In order to reduce the computational burden, the nonscanner data inversion algorithms calculate TOA estimates based on average nonscanner measurements over 32 seconds. Measurement sets for 32-sec nonscanner intervals are saved in the nonscanner data storage array, **XPATNS** (see Tables F-28 and F-29), for subsequent nonscanner data processing. Elements of the **XNSDAT** array are transferred into the appropriate row of the **XPATNS** array as illustrated in the flowchart. If, however, the **XPATNS** array becomes full or if one or more 32-sec nonscanner data intervals are missing (nonscanner data dropout), the following processing occurs.

- The switch flag, SWFLAG, is set to ‘NSCAN’ or ‘IDROP’, as appropriate.
- Data from **XNSDAT** is not accumulated into the **XPATNS** array.
- Scanner data processing is completed for the current 16-sec record.
- Nonscanner data inversion is initiated to process the appropriate data from the **XPATNS** array.

Otherwise, scanner data processing continues. In any case, if the spacecraft subsatellite point falls in a nadir region, elements of the nadir region array are initialized to store scene information from scanner data processing to be included with subsequent nonscanner output to the Daily Data Base Subsystem.

5.2.1.1 <u>Determine Shortwave Filtered Measurement Offsets (SWZERO)</u>. This subroutine calculates orbital shortwave measurement offsets for the NFOV, MFOV, and WFOV instruments in order to correct daytime shortwave filtered measurements to the nighttime “zero reference” value, i.e.

$$SW^{\mathrm{Corrected\ Filtered}}_{\mathrm{Daytime}} = SW^{\mathrm{Filtered}}_{\mathrm{Daytime}} - \mathrm{offset}$$

and

$$SW^{\mathrm{Corrected\ Filtered}}_{\mathrm{Nighttime}} = SW^{\mathrm{Filtered}}_{\mathrm{Nighttime}} - \mathrm{offset} = \text{"zero reference"},$$

where $SW^{\mathrm{Filtered}}_{\mathrm{Nighttime}}$ is the nighttime shortwave radiometric measurement value from the Merge-FOV Subsystem.

This routine is invoked from subroutine RDPAT (#5.2.1) following each successful read of an input-PAT record.

Figure 5.2-4 is a detailed flowchart of the processing algorithm.

Subroutine SWZERO processing follows one of three paths.

1. If the WFOV is in nighttime over the entire 16-sec record, then all shortwave scanner and nonscanner measurements are summed.

2. On the first occurrence of daytime, when the entire WFOV is not in nighttime, the offsets are calculated as shown in the flowchart, and the summing parameters are reinitialized for the next orbital pass through nighttime.

3. On subsequent occurrences of daytime, no action is taken, except for a check for a major data dropout period prior to implementing the offsets in subroutine RDPAT.

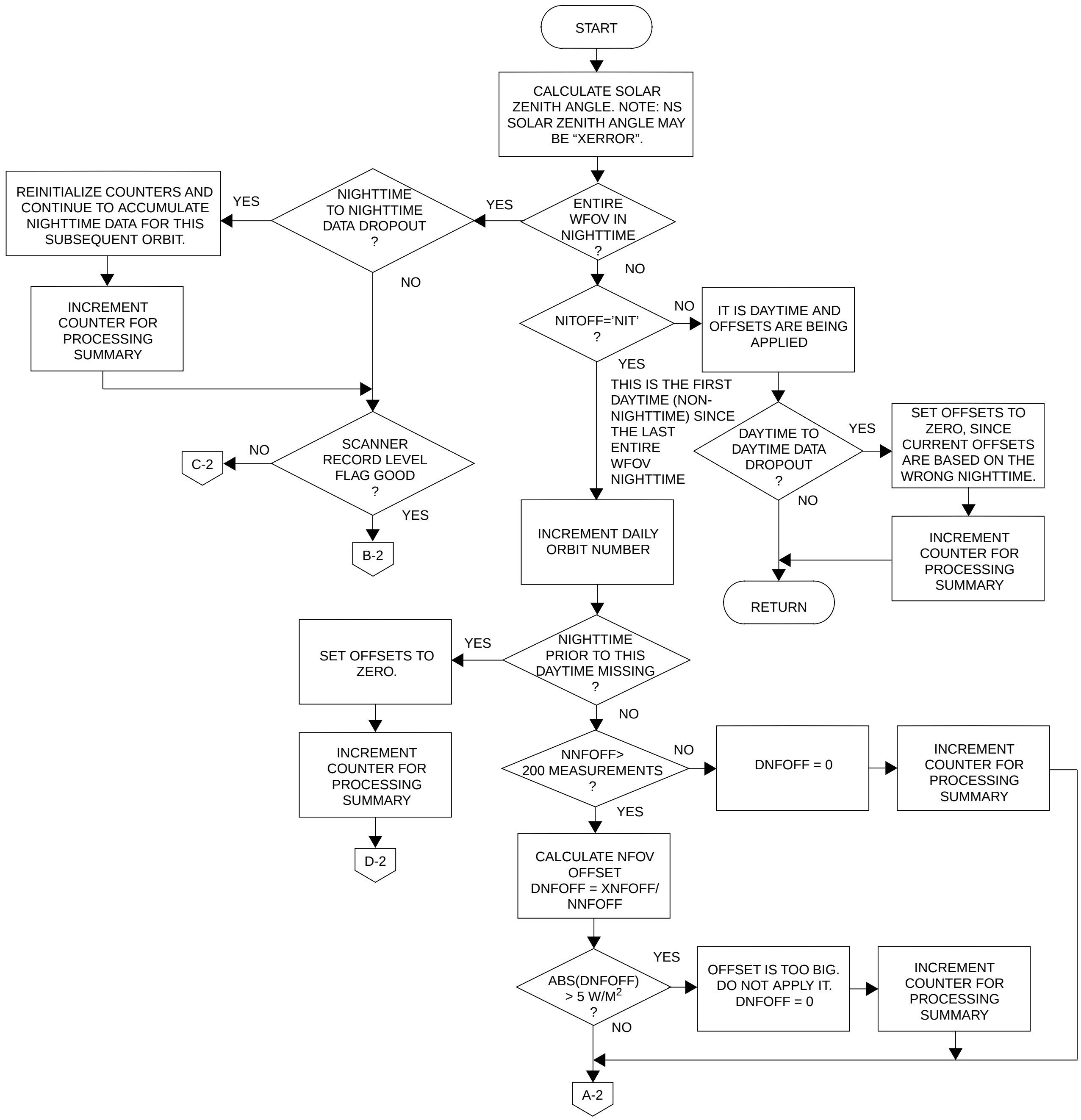


Figure 5.2-4. Flowchart of SWZERO (Module 5.2.1.1) (1 of 2)

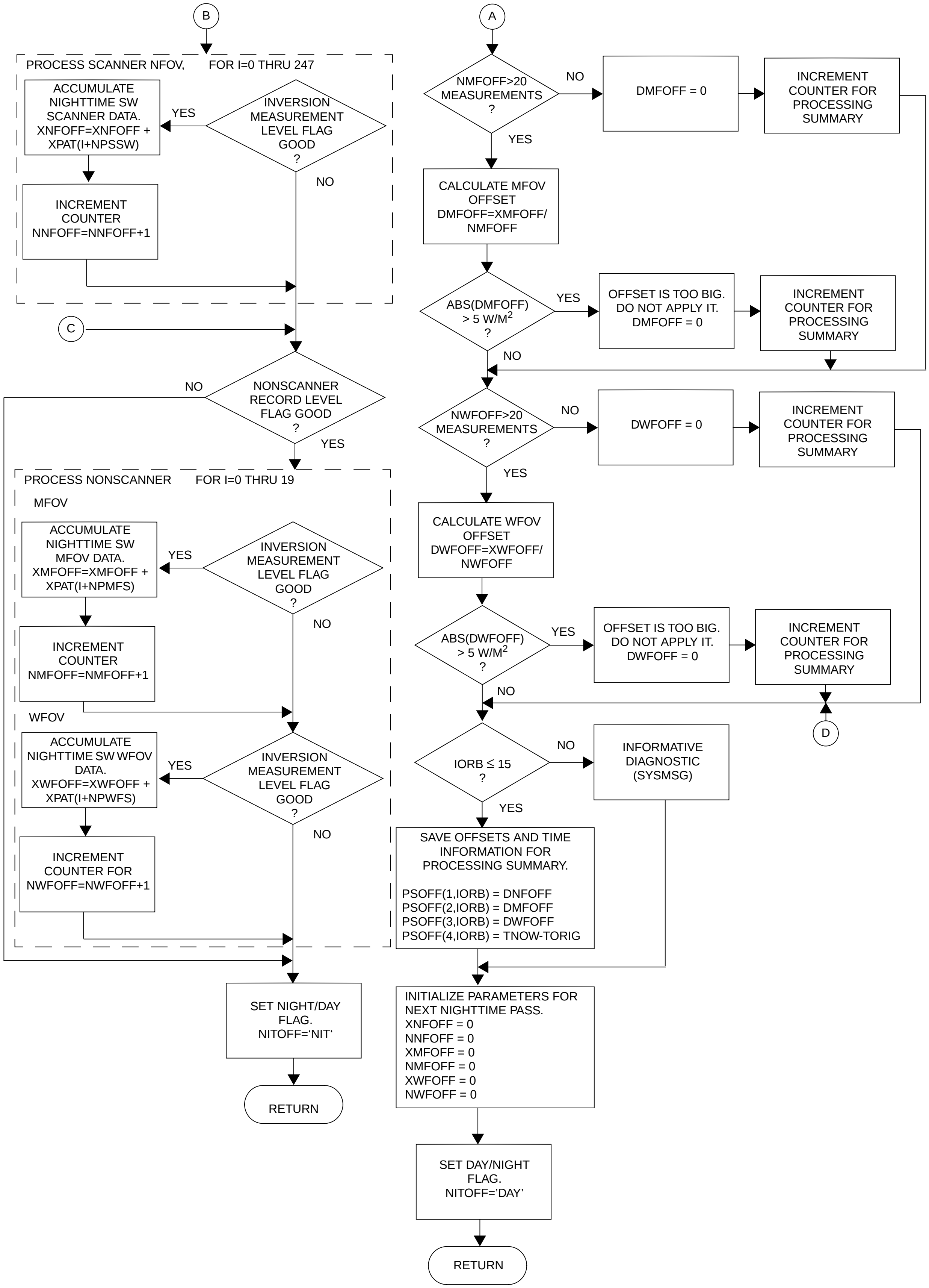


Figure 5.2-4. Flowchart of SWZERO (Module 5.2.1.1) (2 of 2)

The parameters used in this routine to calculate the shortwave offsets are in COMMON Blocks /SWOFF/ and /CSWOFF/ (see Appendix F). These parameters are initialized in subroutine PARINT (#5.1.2).

Several comments regarding the implementation of this routine are made below.

The initial determination of nighttime is based on the solar zenith angle, θ'_0. If

$$\theta'_0 > \mathrm{SUNLIM},$$

the entire WFOV is assumed to be in nighttime. SUNLIM, nominally 118°, is contained in COMMON Block /LIMITS/.

Since the nonscanner solar zenith angle on the input-PAT may contain the Subsystem default value, XERROR (see COMMON Block /USPARM/), the solar zenith is calculated every 16 seconds in this routine from the colatitude and longitude of the subsolar point (θ_0, ϕ_0) and the spacecraft nadir (θ_s, ϕ_s). These angles are contained in the first 22 words of each input-PAT record and therefore will not contain the default value.

The solar zenith angle is calculated as

$$\theta'_0 = \cos^{-1}(x_s x_0 + y_s y_0 + z_s z_0)$$

where

$$\begin{aligned} x_s &= \sin(\theta_s)\cos(\phi_s), \\ y_s &= \sin(\theta_s)\sin(\phi_s), \\ z_s &= \cos(\theta_s), \\ x_0 &= \sin(\theta_0)\cos(\phi_0), \\ y_0 &= \sin(\theta_0)\sin(\phi_0), \end{aligned}$$

and

$$z_0 = \cos(\theta_0).$$

Before a particular nighttime measurement is included in the offset accumulator, the associated Inversion Subsystem measurement level flag (see

COMMON Block /FLAG/ in Appendix F), as set in subroutine RDAT (#G.5.1), must check as good. These flags are based on the FOV and radiometric flags from the input-PAT record and are set to good only if both of those flags are good.

In determining the offsets, two constraints must be met. First, a minimum number of measurements (nominally 200 for NFOV, and 20 for both MFOV and WFOV) must be available before the offset is calculated. Secondly, the absolute value of the calculated offset must not exceed some value, nominally 5 w/m^2. If either constraint is not met, the appropriate offset is set to zero, so that no offset will be applied to the filtered shortwave measurement for that orbit.

There is a data dropout test associated with each of the three processing paths mentioned above. The first test is made prior to summing nighttime offsets. If there is a data drop of over one-half the orbital period, the previously summed offsets must be from nighttime during a previous orbit, and all offset accumulators and counters are reinitialized to zero.

The second test is made prior to calculating offsets. If the entire previous orbit is missing, then the accumulated offsets, if any, must be from a previous orbit’s nighttime, and the NFOV, MFOV, and WFOV offsets are set to zero. Otherwise, the required offsets are calculated.

The final data dropout test is made each 16 seconds during routine processing of daytime data. In this case, if there was a dropout of over one-half an orbit, then the available (already calculated) offsets are for a previous daytime, so all offsets are reinitialized to zero.

The results of the shortwave measurement offset calculations are shown on page six of the Main-Processor Processing Summary (see Section 5.4.2 and Figure B-2).

5.2.2 SPECTRAL CORRECTION ALGORITHM (SPCOR)

The purpose of the spectral correction algorithm is to estimate an unfiltered shortwave measurement and an unfiltered longwave measurement from the incoming filtered measurements from the shortwave, longwave, and total scanner instrument channels. The unfiltered measurements are calculated by

$$m^{SW} = A_c^{SW} m_f^{SW} + B_c^{SW} m_f^{LW} + C_c^{SW} m_f^{TOT}$$

and

$$m^{LW} = A_c^{LW} m_f^{SW} + B_c^{LW} m_f^{LW} + C_c^{LW} m_f^{TOT}$$

where A_c^{SW}, B_c^{SW}, C_c^{SW}, A_c^{LW}, B_c^{LW}, and C_c^{LW} are "composite" spectral correction coefficients, and m_f^{SW}, m_f^{LW}, and m_f^{TOT} are the filtered scanner measurements.

These equations may be written in matrix form such that

$$\begin{bmatrix} m^{SW} \\ m^{LW} \end{bmatrix} = \mathbf{C} \begin{bmatrix} m_f^{SW} \\ m_f^{LW} \\ m_f^{TOT} \end{bmatrix}$$

where

$$\mathbf{C} = \begin{bmatrix} A_c^{SW} & B_c^{SW} & C_c^{SW} \\ A_c^{LW} & B_c^{LW} & C_c^{LW} \end{bmatrix}.$$

In order to implement the spectral correction algorithm, this subroutine selects two sets of coefficients. One is based on the geo-scene (see Table A-5), and the other is for an overcast sky condition. From these, a set of composite coefficients, **C**, are determined by using a cloud cover weighting factor.

This algorithm is actually implemented twice (see Figure 5.2-5). The first time a precomputed cloud cover weighting factor is used, and a set of intermediate unfiltered measurements are calculated. These measurements are used by the ERBE scene identification algorithm (see subroutine SCNID, #5.2.2.1) which determines a “better” estimate of the cloud cover. With this information a final set of composite coefficients are determined which are used to calculate the unfiltered shortwave and longwave measurements as described above. Figure 5.2-6 is a detailed flowchart of this subroutine. This flowchart and the following narrative should provide an understanding of how the spectral correction algorithm is implemented.

Precomputed spectral correction coefficients (see Sections A.1 and A.3) are stored in the **SPCCDY** array for unfiltering daytime measurements and in the **SPCCNT** array for unfiltering nighttime measurements. The daytime coefficients are a function of the spectral correction scene type index, ISCN, and the angular bin indices for the spacecraft zenith, solar zenith, and relative azimuth angles. The spectral correction algorithm scene types are shown in Table 5.2-3. These scene types are a function of both underlying scene and colatitude. The six colatitudinal zones are defined in Table 5.2-3. The scene type, ISCN, is actually determined from the **IGEOCN** array (see Table 5.2-4) in terms of the geo-scene index, NGEO, and the colatitudinal zone index, LATZON, which is described in Table 5.2-3.

In the case of a mixed geo-scene type (NGEO = 5), the **IGEOCN** array returns the appropriate spectral correction scene type for ocean. Later in the processing, ocean and land coefficients are combined to form the set of coefficients based on geo-scene.

Tables 5.2-5, 5.2-6, and 5.2-7 show the angular bin indices LZEN, LSUN, and LAZ, respectively.

The array COEF(0:20) is used to store 20 daytime coefficients from the **SPCCDY** array, such that

```
COEF(JCOEF) = SPCCDY(ISCN, LZEN, LSUN, LAZ, JCOEF)
```

for JCOEF = 1 to 20.

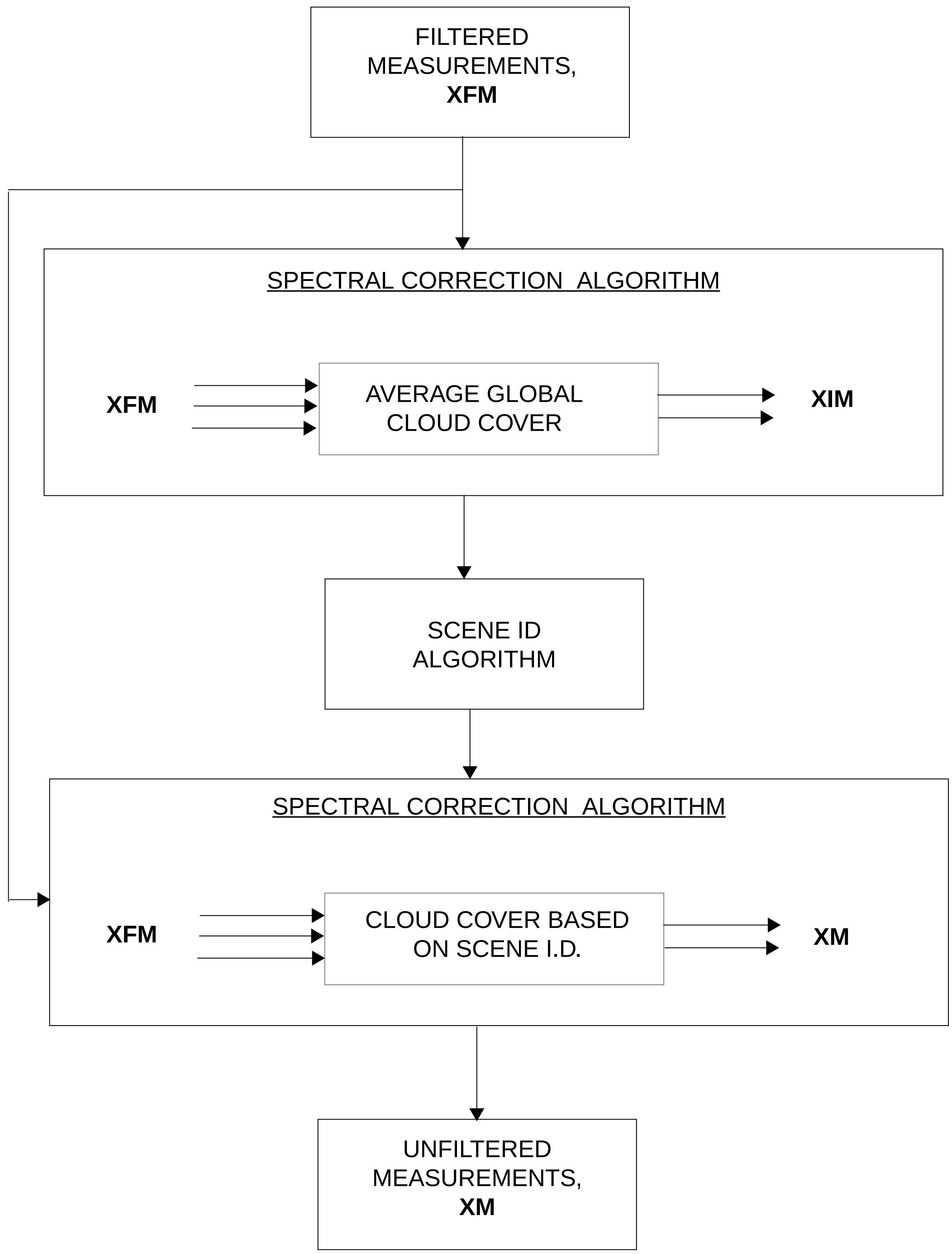


Figure 5.2-5. Implementation of the Spectral Correction Algorithm

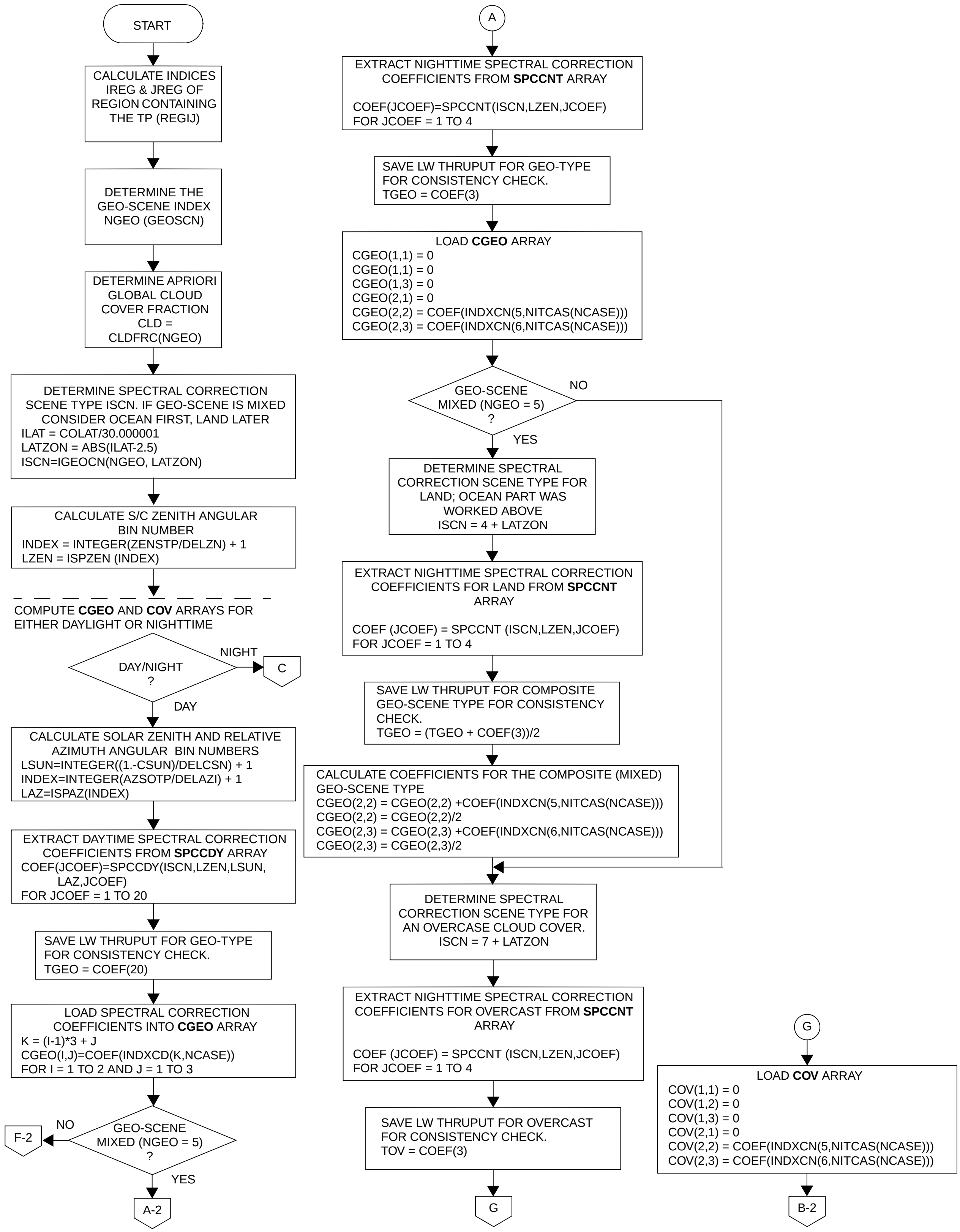


Figure 5.2-6. Flowchart of SPCOR (Module 5.2.2) (1 of 3)

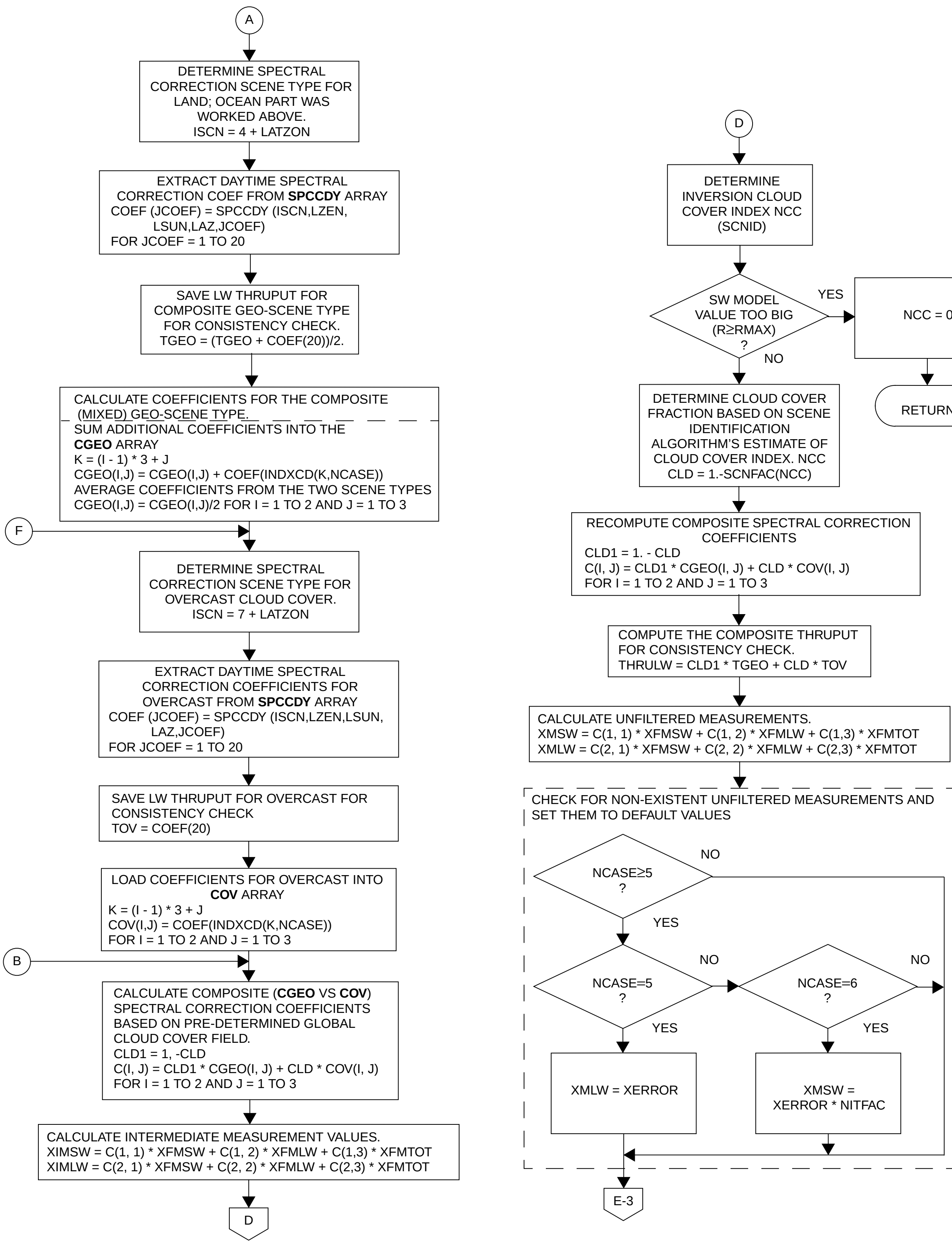


Figure 5.2-6. Flowchart of SPCOR (Module 5.2.2) (2 of 3)

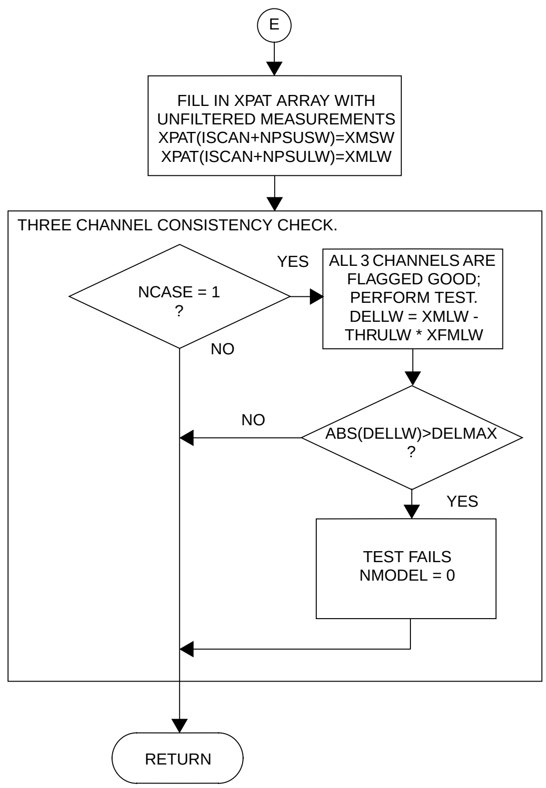


Figure 5.2-6. Flowchart of SPCOR (Module 5.2.2) (3 of 3)

Table 5.2-3a Spectral Correction
Algorithm Scene Types.

SCENE	TROPICS	MID-LATITUDES	POLAR
Ocean	1	2	3
Land	4	5	6
Cloud	7	8	9
Snow		10	11
Desert	12	12	

Table 5.2-3b. Spectral Correction
Algorithm Colatitudinal Zones.

COLATITUDINAL ZONES	ILAT	LATZON	COLATITUDINAL COVERAGE	
			θ	2.5° INDEX (IREG)
N. Polar	0	2	$0° \leq \theta \leq 30°$	1 - 12
N. Mid-Lat.	1	1	$30° < \theta \leq 60°$	13 - 24
N. Tropics	2	0	$60° < \theta \leq 90°$	25 - 36
S. Tropics	3	0	$90° < \theta \leq 120°$	37 - 48
S. Mid-Lat.	4	1	$120° < \theta \leq 150°$	49 - 60
S. Polar	5	2	$150° < \theta \leq 180°$	61 - 72

Table 5.2-4. **IGEOCN** Array Values.

GEO-SCENE TYPE	NGEO	IGEOCN(NGEO, LATZON)			
		LATZON =	0	1	2
Ocean	1		1	2	3
Land	2		4	5	6
Snow	3		10	10	11
Desert	4		12	12	-999
Ocean-land	5		1	2	3

Table 5.2-5. Spacecraft Zenith Angle Index, LZEN.

SPACECRAFT ZENITH ANGLE (θ'_s)	INDEX	LZEN
$0° \le \theta'_s \le 15°$	1	1
$15° < \theta'_s \le 30°$	2	1
$30° < \theta'_s \le 45°$	3	2
$45° < \theta'_s \le 60°$	4	3
$60° < \theta'_s \le 75°$	5	4
$75° < \theta'_s \le 90°$	6	4

NOTES: 1. LZEN = ISPZEN(INDEX).
2. **ISPZEN** is an input array (See COMMON Block /CONST/).

Table 5.2-6. Solar Zenith Angle Index, LSUN.

SOLAR ZENITH ANGLE (θ'_0)	COS (θ'_0) (CSUN)	LSUN
$0° \le \theta'_0 \le 41.4°$	$0.75 \le CSUN \le 1.00$	1
$41.4° < \theta'_0 \le 60.0°$	$0.50 \le CSUN < 0.75$	2
$60.0° < \theta'_0 \le 75.5°$	$0.25 \le CSUN < 0.50$	3
$75.5° < \theta'_0 \le 90.0°$	$0.00 \le CSUN < 0.25$	4

NOTE: 1. LSUN = INT((1. - CSUN) / 0.250001) + 1.

Table 5.2-7. Relative Azimuth Angle Index, LAZ.

RELATIVE AZIMUTH ANGLE (ϕ_r)	INDEX	LAZ
$0° \leq \phi_r \leq 15°$	1	1
$15° < \phi_r \leq 30°$	2	2
$30° < \phi_r \leq 45°$	3	2
$45° < \phi_r \leq 60°$	4	2
$60° < \phi_r \leq 75°$	5	3
$75° < \phi_r \leq 90°$	6	3
$90° < \phi_r \leq 105°$	7	3
$105° < \phi_r \leq 120°$	8	3
$120° < \phi_r \leq 135°$	9	4
$135° < \phi_r \leq 150°$	10	4
$150° < \phi_r \leq 165°$	11	4
$165° < \phi_r \leq 180°$	12	5

NOTES: 1. LAZ = ISPAZ(INDEX).

2. **ISPAZ** is an input array (See COMMON Block /CONST/).

The first element (zeroth) of **COEF** is initialized to zero in subroutine PARINT (#5.1.2).

A set of six spectral correction coefficients must be determined from these 20 based on the availability of data from the three scanner channels. This selection is illustrated in Table 5.2-8.

These six spectral correction coefficients are found by

$$CGEO_1(I, J) = COEF(INDXCD(K, NCASE))$$

where

$$K = (I - 1) * 3 + J,$$

$$I = 1 \text{ to } 2,$$

and

$$J = 1 \text{ to } 3.$$

INDXCD is an indexing array for selecting spectral correction coefficients as shown below.

NCASE Parameter

$$\mathbf{INDXCD} = \begin{array}{c|cccccc|ll}
 & 1 & 2 & 3 & 4 & 5 & 6 & & \\
1 & 1 & 7 & 11 & 0 & 19 & 0 & A^{SW} & \\
2 & 2 & 8 & 0 & 15 & 0 & 0 & B^{SW} & \text{SW Coefficient Element No.} \\
3 & 3 & 0 & 12 & 16 & 0 & 0 & C^{SW} & \\
\hline
4 & 4 & 9 & 13 & 0 & 0 & 0 & A^{LW} & \\
5 & 5 & 10 & 0 & 17 & 0 & 20 & B^{LW} & \text{LW Coefficient Element No.} \\
6 & 6 & 0 & 14 & 18 & 0 & 0 & C^{LW} &
\end{array}$$

Table 5.2-8. Coefficient Requirement Based on Availability of Scanner Data

NCASE CHANNEL AVAILABILITY	1	2	3	4	5	6	7
SHORTWAVE	✓	✓	✓		✓		
LONGWAVE	✓	✓		✓		✓	
TOTAL	✓		✓	✓			✓
No. of Daytime Coefficients Required	6	4	4	4	1	1	0
No. of Daytime Coefficients per Set	20						
No. of Nighttime Coefficients Required	0	0	0	2	0	1	1
No. of Nighttime Coefficients per Set	4						

Example

Suppose NCASE = 6; this means only data from the longwave scanner channel are available. Then,

$$A^{SW} = B^{SW} = C^{SW} = A^{LW} = C^{LW} = \mathrm{COEF}(0) = 0.,$$

and

$$\mathrm{CGEO}_1(2,\ 2) = B^{LW} = \mathrm{COEF}(\mathrm{INDXCD}(5,\ 6)) = \mathrm{COEF}(20).$$

In the case of a mixed geo-scene (NGEO = 5), the array **CGEO**$_2$ is calculated just as **CGEO**$_1$ is above, except that the scene type for land must be substituted for ocean when retrieving the 20 coefficients from the **SPCCDY** array, i.e.

$$\mathrm{ISCN}_{land} = \mathrm{LATZON} + 4$$

and

$$\mathrm{COEF}(\mathrm{JCOEF}) = \mathrm{SPCCDY}(\mathrm{ISCN}_{land},\ \mathrm{LZEN},\ \mathrm{LSUN},\ \mathrm{LAZ},\ \mathrm{JCOEF})$$

for JCOEF = 1 to 20 as before. Then, the set of coefficients based on geo-scene is

$$\mathbf{CGEO} = \frac{\mathbf{CGEO}_1 + \mathbf{CGEO}_2}{2}.$$

If the geo-scene is not mixed,

$$\mathbf{CGEO} = \mathbf{CGEO}_1.$$

A set of six spectral correction coefficients for ISCN = LATZON + 7 (cloud) is determined in a similar manner. These coefficients are stored in the **COV** array.

The composite coefficients are calculated from the matrix equation

$$\mathbf{C} = (1 - CLD)\ \mathbf{CGEO} + CLD\ \mathbf{COV},$$

where

CLD = CLDFRC(NGEO)

is the apriori average global cloud cover for the geographic scene type, NGEO (see Section 5.2.2.1, Table 5.2-9).

A set of interim unfiltered measurements, $\mathbf{m}_i$, is calculated such that

$$\mathbf{m}_i = \mathbf{C}\ \mathbf{m}_f.$$

These measurements are input into the scene identification algorithm which determines a “better” estimate of the cloud cover. This information is returned through the cloud cover index, NCC (see Section 5.2.2.1, Table 5.2-10). The **C** matrix is recomputed with

CLD = 1 - SCNFAC(NCC)

where the **SCNFAC** array (see Table A-3) contains the predetermined fractional cloud cover associated with each of the four cloud cover categories. The unfiltered measurements are computed from

$$\mathbf{m} = \mathbf{C}\ \mathbf{m}_f.$$

Calculating unfiltered measurements at nighttime is similar. The nighttime coefficients are a function of the spectral correction scene type index, ISCN, and the angular bin index for the spacecraft zenith angle. A set of four nighttime coefficients (see Table 5.2-8) are selected as follows

COEF(JCOEF) = SPCCNT(ISCN, LZEN, JOEF)

for JCOEF = 1 to 4.

The six nighttime coefficients required by the unfiltering algorithm are

$$CGEO_1(1, 1) = CGEO_1(1, 2) = CGEO_1(1, 3) = CGEO_1(2, 1) = 0.,$$

$$CGEO_1(2, 2) = COEF(INDXCN(5, NITCAS(NCASE))),$$

and

$$CGEO_1(2, 3) = COEF(INDXCN(6, NITCAS(NCASE))),$$

where

$$\begin{array}{cc} & \underline{NITCAS(NCASE)} \\ & \begin{array}{ccc} 1 & 2 & 3 \end{array} \\ \mathbf{INDXCN} = \begin{array}{c} 5 \\ 6 \end{array} & \begin{bmatrix} 1 & 3 & 0 \\ 2 & 0 & 4 \end{bmatrix} \begin{array}{c} B^{LW} \\ C^{LW} \end{array} \end{array}$$

The NITCAS array is tabulated below.

NCASE	NITCAS(NCASE)
1	1
2	2
3	3
4	1
5	0
6	2
7	3

Example

Suppose NCASE = 2, and it is nighttime. This means that data from the shortwave and longwave channels are available; however, the algorithm assumes the shortwave contribution at night is zero. Then,

$$A^{SW} = B^{SW} = C^{SW} = A^{LW} = 0.,$$

$$B^{LW} = \mathrm{COEF(INDXCN(5,\ NITCAS(2)))} = \mathrm{COEF(3)},$$

and

$$C^{LW} = \mathrm{COEF(INDXCN(6,\ NITCAS(2)))} = \mathrm{COEF(0)} = 0.$$

The rest of the nighttime problem is handled synonymously to the daytime problem.

Subroutine SPCOR will not be invoked if

a. all three (filtered) scanner channels are determined to be invalid,

b. it is nighttime and only the shortwave scanner channel contains valid data,

or

c. it is daytime and only the total scanner channel contains valid data.

5.2.2.1 Scene Identification Algorithm (SCNID). The Inversion Subsystem utilizes 12 scene types which are found by the scene identification algorithm. These are shown in Table A-4. The scene types are formed by combining geographic regional scene data with the most probable cloud cover, which is determined statistically using the bivariate normal distribution. The geographic scene types and cloud cover conditions are shown separately in Tables 5.2-9 and 5.2-10 below.

Table 5.2-9. Categories of Geographic Scene Type

GEOGRAPHIC SCENE TYPES	
Index (NGEO)	Description
1	Ocean
2	Land
3	Snow
4	Desert
5	Land-ocean

Table 5.2-10. Categories of Cloud Cover Conditions

CLOUD COVER CONDITIONS	
Index (NCC)	Description
1	Clear
2	Partly-cloudy
3	Mostly-cloudy
4	Overcast

The probability that the cloud cover with the associated index NCC produces the unfiltered scanner measurements m_{SW} and m_{LW} is given by

$$P = \frac{1}{2\pi\ \sigma_{NCC}(SW)\sigma_{NCC}(LW)} e^{-G/2},$$

where

$$G = \left(\frac{m_{SW} - L_{NCC}(SW)}{\sigma_{NCC}(SW)}\right)^2 + \left(\frac{m_{LW} - L_{NCC}(LW)}{\sigma_{NCC}(LW)}\right)^2.$$

The following parameters come from ancillary input data (see Tables A-6a and A-6b):

$\sigma_{NCC}(SW)$ is the standard deviation of radiance for the elements of a shortwave bidirectional model,

and

$\sigma_{NCC}(LW)$ is the standard deviation of radiance for the elements of a longwave anisotropic model.

Also,

$$L_{NCC}(SW) = \frac{1}{\pi} E_o\, l(t) \mu'_o \hat{a}_{NCC} R_{NCC}(KSUN, KZEN, KAZ)$$

and

$$L_{NCC}(LW) = \frac{1}{\pi} \hat{M}_{NCC} A_{NCC}(KZEN, KCOLAT)$$

are the estimated or nominal shortwave and longwave radiances. $E_o l$ (t) is the solar constant corrected for the Earth-sun distance (l(t) is the reciprocal of the Earth-sun distance squared). μ'_o is the cosine of the solar zenith angle. $\hat{a}_{NCC}$ and $\hat{M}_{NCC}$ are the estimated albedo and longwave radiant exitances over a cloud cover with index NCC (these quantities are shown as ACC and RELWCC in the flowchart, Figure 5.2-7). R_{NCC} and A_{NCC} are the shortwave bidirectional model and the longwave anisotropic model values, respectively, selected on the basis of the geographic scene type and the cloud cover. The indices required to identify the proper elements of the selected models are calculated in subroutine SCINV (#5.2) and are shown in Table 5.2-11.

The process of calculating the probability, P, is repeated for all four values of NCC (note that the geo-scene index, NGEO, is fixed for each set of m_{SW} and m_{LW}). If the probability just calculated is greater than or equal to the previous probability, then both the current probability and value of NCC are saved. When all four cloud conditions have been examined, the Inversion Subsystem scene type model index is selected such that

NMODEL = **MODEL**(NCC, NGEO).

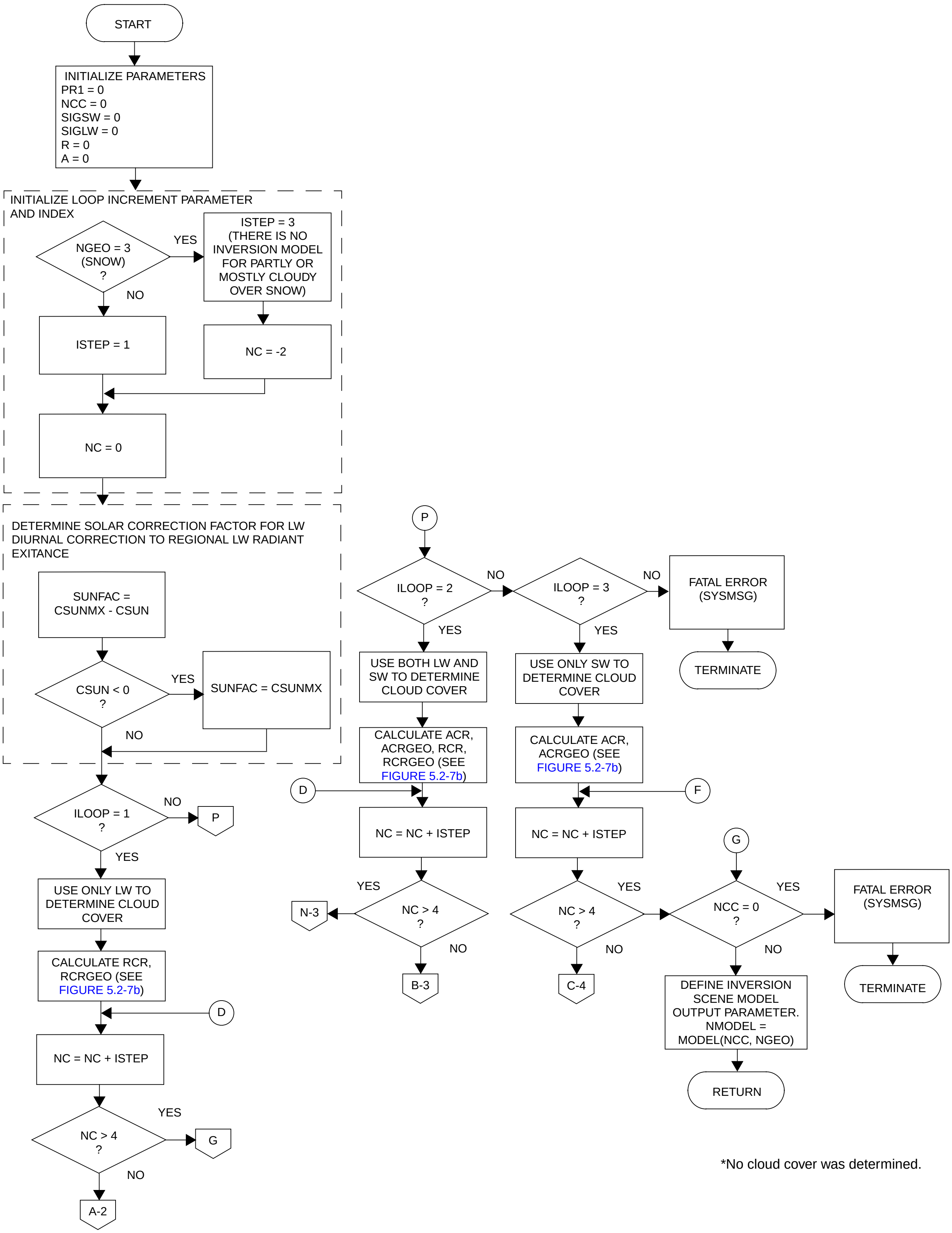


Figure 5.2-7. Flowchart of SCNID (Module 5.2.2.1) (1 of 5)

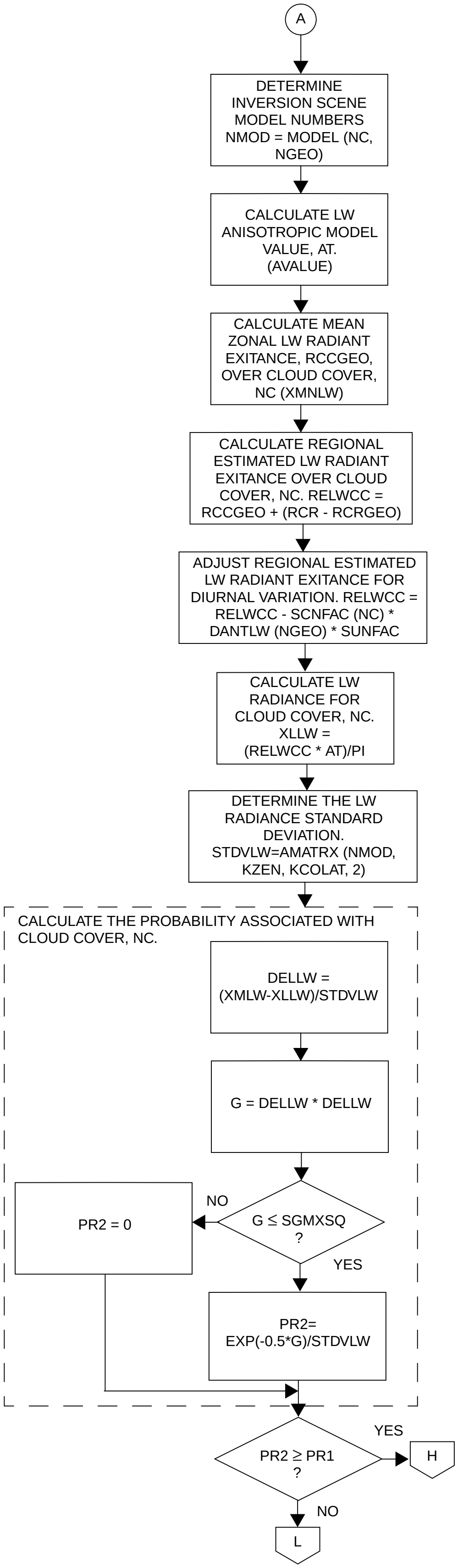


Figure 5.2-7. Flowchart of SCNID (Module 5.2.2.1) (2 of 5)

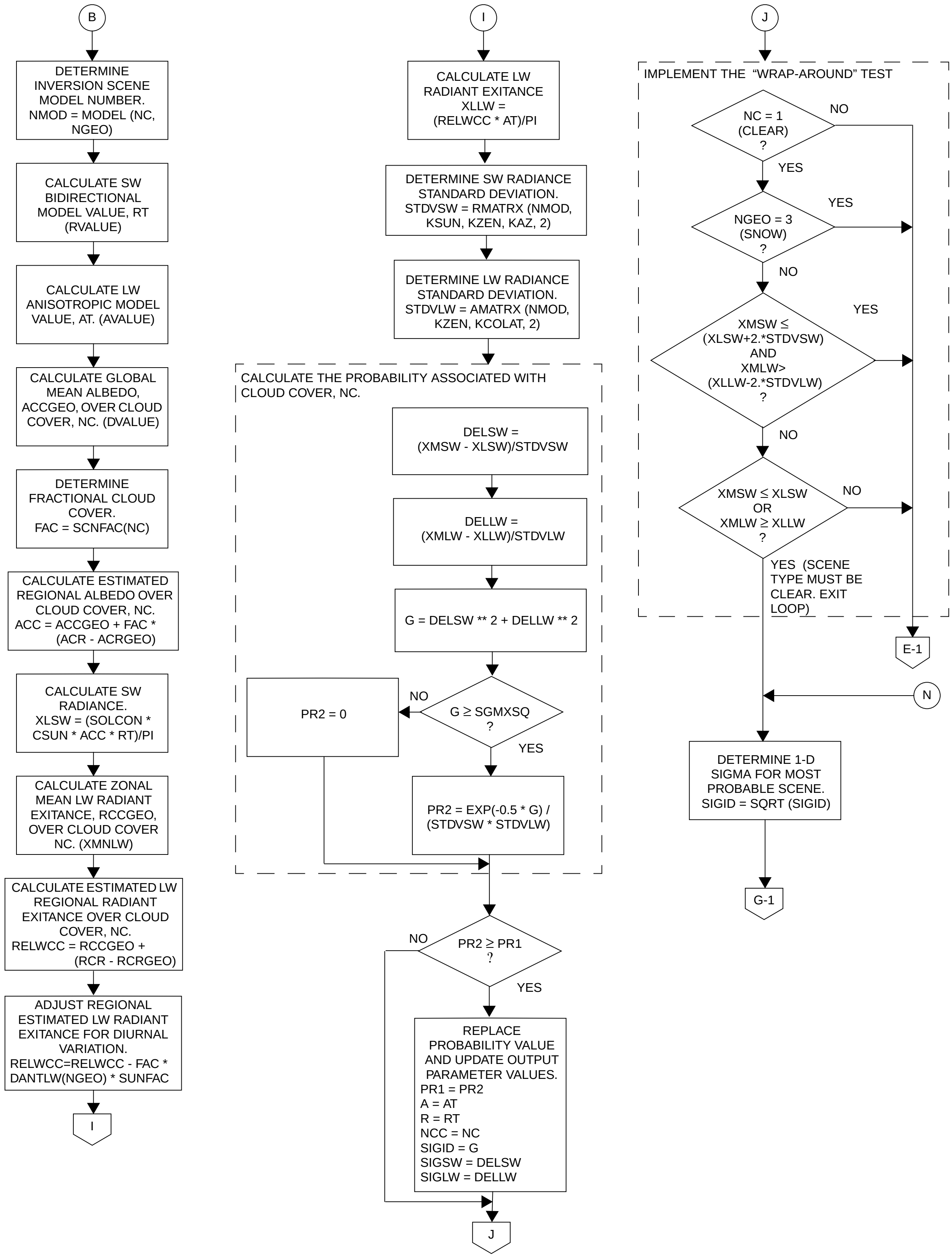


Figure 5.2-7. Flowchart of SCNID (Module 5.2.2.1) (3 of 5)

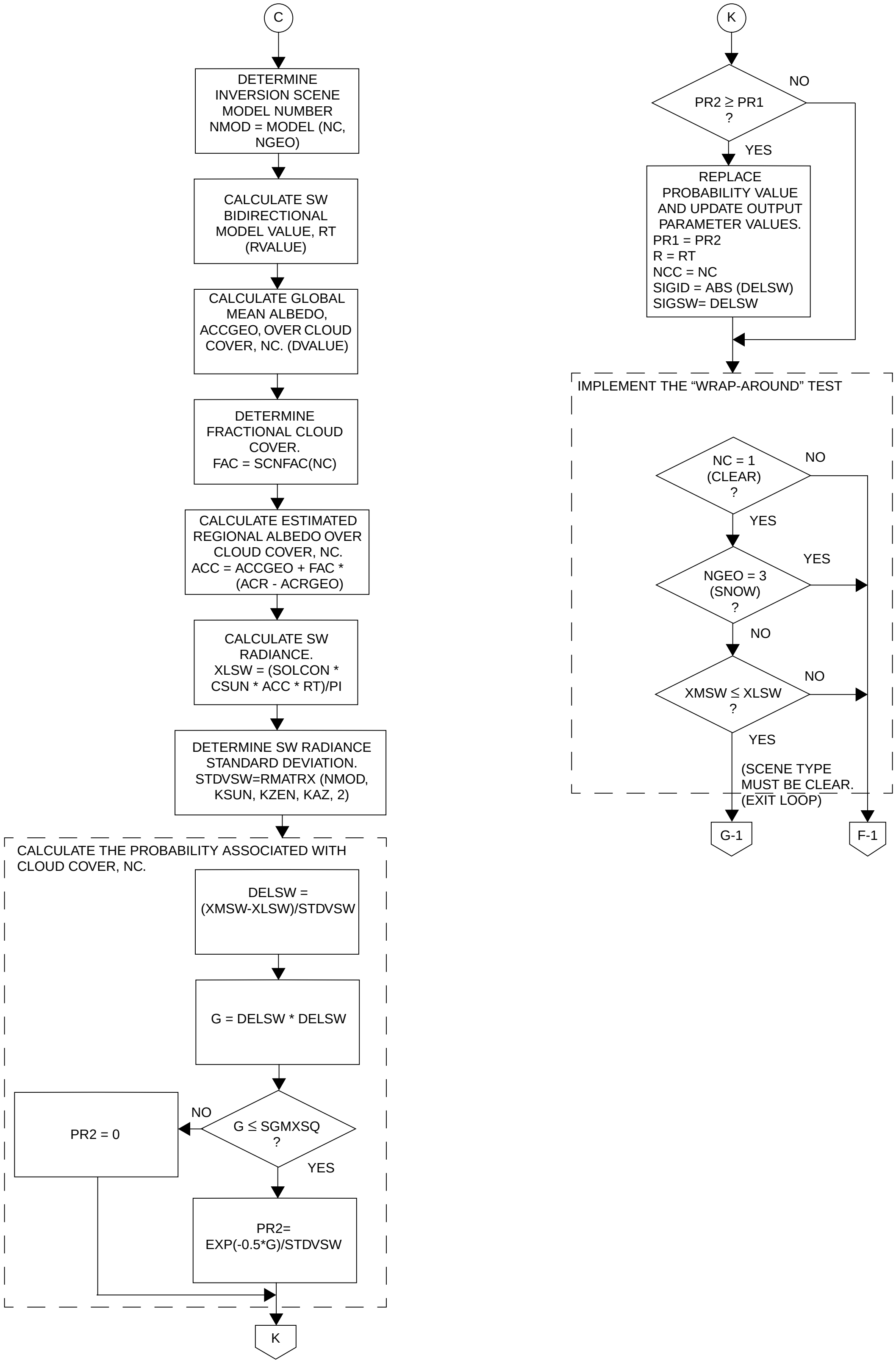


Figure 5.2-7. Flowchart of SCNID (Module 5.2.2.1) (4 of 5)

Supplement to Flowchart of SCNID

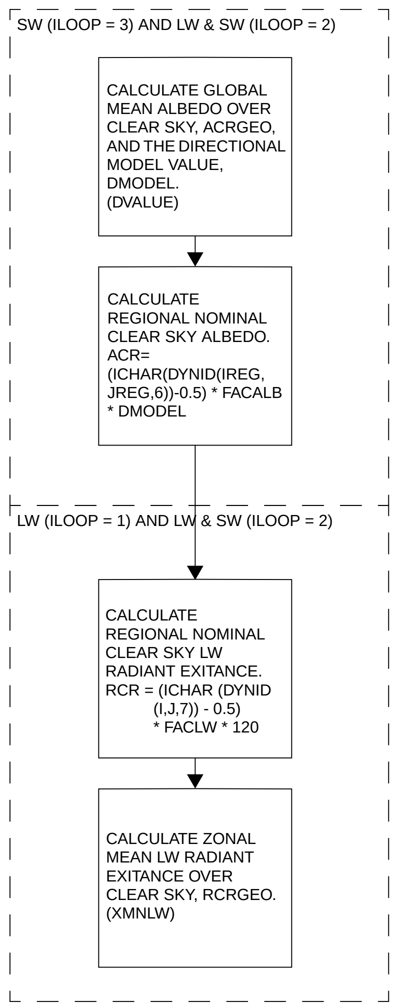


Figure 5.2-7. Flowchart of SCNID (Module 5.2.2.1) (5 of 5)

Table 5.2-11. The Indexes : KSUN, KZEN, KAZ and KCOLAT (1 of 4)

KSUN =	INT((1. - CSUN) * DELSUN) + 1
1	$0.9 \le CSUN \le 1.0$
2	$0.8 \le CSUN < 0.9$
3	$0.7 \le CSUN < 0.8$
4	$0.6 \le CSUN < 0.7$
5	$0.5 \le CSUN < 0.6$
6	$0.4 \le CSUN < 0.5$
7	$0.3 \le CSUN < 0.4$
8	$0.2 \le CSUN < 0.3$
9	$0.1 \le CSUN < 0.2$
10	$0.0 \le CSUN < 0.1$
NOTES: 1. CSUN is the cosine of the solar zenith angle. 2. DELSUN = 9.999999.	

Table 5.2-11. The Indexes : KSUN, KZEN, KAZ and KCOLAT (2 of 4)

KZEN = IZEN (INDEX)	INDEX	
1	1 - 5	$0° \le ZENSTP \le 15°$
2	6 - 9	$15° < ZENSTP \le 27°$
3	10 - 13	$27° < ZENSTP \le 39°$
4	14 - 17	$39° < ZENSTP \le 51°$
5	18 - 21	$51° < ZENSTP \le 63°$
6	22 - 25	$63° < ZENSTP \le 75°$
7	26 - 30	$75° < ZENSTP \le 90°$

NOTES:

1. **IZEN** is an input array of 30 elements from NAMELIST $NCONST.
2. INDEX = INT(ZENSTP/DELZEN) + 1.
3. ZENSTP is the spacecraft zenith angle.
4. DELZEN = 3.000001.

Table 5.2-11. The Indexes : KSUN, KZEN, KAZ and KCOLAT (3 of 4)

KAZ = IAZ (INDEX)	INDEX	
1	1 - 3	$0° \le AZSOTP \le 9°$
2	4 - 10	$9° < AZSOTP \le 30°$
3	11 - 20	$30° < AZSOTP \le 60°$
4	21 - 30	$60° < AZSOTP \le 90°$
5	31 - 40	$90° < AZSOTP \le 120°$
6	41 - 50	$120° < AZSOTP \le 150°$
7	51 - 57	$150° < AZSOTP \le 171°$
8	58 - 60	$171° < AZSOTP \le 180°$

NOTES:

1. **AZSOTP** is the relative azimuth.
2. **IAZ** is an input array of 60 elements from NAMELIST $NCONST.
3. INDEX = INT (AZSOTP/DELAZ) + 1.
4. DELZAZ = 3.000001.

Table 5.2-11. The Indexes : KSUN, KZEN, KAZ and KCOLAT (4 of 4)

KCOLAT =	INT(COLAT/DELCLT) + 1
1	$0° \le COLAT \le 18°$
2	$18° < COLAT \le 36°$
3	$36° < COLAT \le 54°$
4	$54° < COLAT \le 72°$
5	$72° < COLAT \le 90°$
6	$90° < COLAT \le 108°$
7	$108° < COLAT \le 126°$
8	$126° < COLAT \le 144°$
9	$144° < COLAT \le 162°$
10	$162° < COLAT \le 180°$
NOTES: 1. COLAT is the colatitude of the scanner target. 2. DELCLT = 18.000001.	

The **MODEL** array is described in Table 5.2-12 below.

Table 5.2-12. **MODEL** Array Contains the Mapping From Cloud Cover and Geo-Scene Indices to an Inversion Subsystem Scene Type Index

		GEOGRAPHIC SCENE INDEX (NGEO)				
		1	2	3	4	5
CLOUD COVER INDEX, NCC	1	1	2	3	4	5
	2	6	7	0	7	8
	3	9	10	0	10	11
	4	12	12	12	12	12

In the case that only the shortwave measurement is available, the probability is calculated by

$$P = \frac{1}{\sigma_{NCC}(SW)\sqrt{2\pi}} \; e^{-G/2}$$

where

$$G = \left(\frac{m_{SW} - L_{NCC}(SW)}{\sigma_{NCC}(SW)}\right)^2 .$$

When only the longwave measurement is available, then

$$P = \frac{1}{\sigma_{NCC}(LW)\sqrt{2\pi}} \; e^{-G/2}$$

where

$$G = \left(\frac{m_{LW} - L_{NCC}(LW)}{\sigma_{NCC}(LW)}\right)^2 .$$

Several comments concerning the computational techniques as implemented in the Inversion Subsystem software follow. These procedures are shown in Figure 5.2-7 which displays the processing flow of subroutine SCNID.

- There are three separate processing options controlled by the ILOOP parameter as determined in subroutine SCINV (#5.2).

    - ILOOP = 1, determine scene type with only longwave measurement.

    - ILOOP = 2, determine scene type with both longwave and shortwave measurements.

    - ILOOP = 3, determine scene type with only shortwave measurement.

- Within each of the three processing options, mentioned above, the probability calculations for each of the four cloud cover categories are controlled by a loop that ranges over $1 \le NC \le 4$. However, when the underlying geo-scene is snow, NGEO = 3, NC takes on only the values of 1 (clear) and 4 (overcast), since there are no Inversion Subsystem models for partly-cloudy or mostly-cloudy over snow.

- As shown in the flowchart, the regional estimated LW radiant exitance is “adjusted” for diurnal variation according to:

    RELWCC = RELWCC - SCNFAC(NC) * DANTLW(NGEO) * SUNFAC.

    The array **SCNFAC** is contained in COMMON Block /SPECOR/ and **DANTLW** is contained in COMMON Block /ID1/. SUNFAC is defined in this routine as

$$\mathrm{SUNFAC} = \begin{cases} \mathrm{CSUNMX}, & \text{for } \cos(\theta'_0) < 0 \\ \mathrm{CSUNMX} - \cos(\theta'_0), & \text{otherwise} \end{cases}$$

where

$$\text{CSUNMX} = \begin{cases} \cos(\theta - \theta'_0) \\ 0, \text{for } \cos(\theta - \theta'_0) < 0 \end{cases}$$

from subroutine SCINV (#5.2).

- In the equation for the probability in the text, there is a 2π in the denominator ($\sqrt{2\pi}$ in the case when only longwave data or only shortwave data are available). The scene identification algorithm does not incorporate this 2π in the probability calculations since it is only the relative magnitude that is required for comparison purposes.

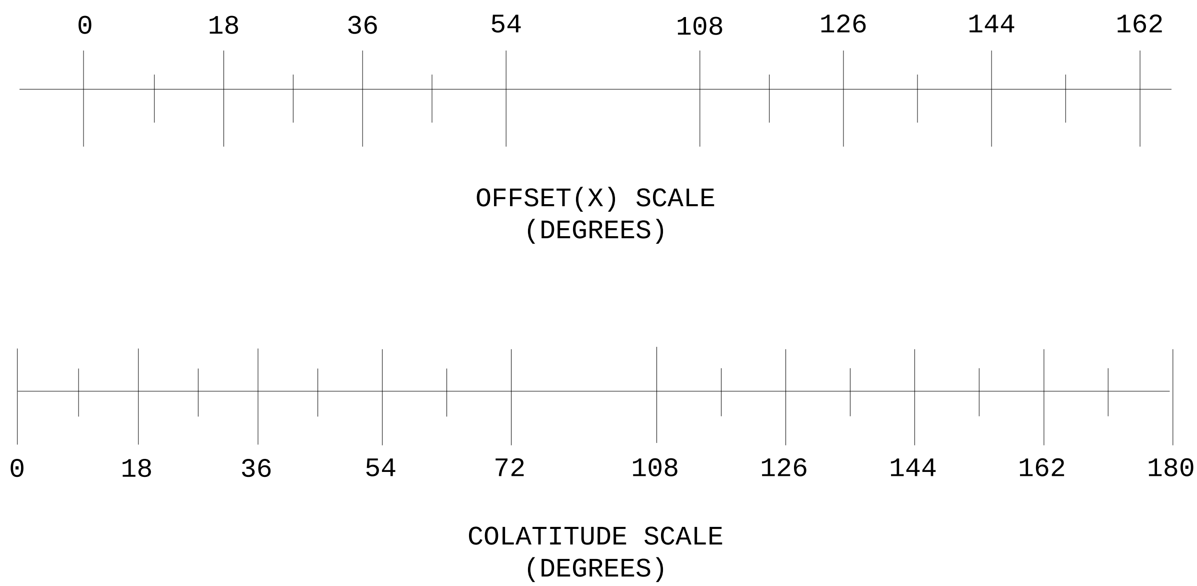
- As indicated in the flowchart, several quantities used in the scene identification algorithm that are based on discrete input data are calculated by different linear interpolation routines. These are listed below.

MODULE		QUANTITY CALCULATED
NAME	NUMBER	
XMNLW	5.2.2.1.1	LW Radiant Exitance
RVALUE	G.5.12	SW Bidirectional Model Value
AVALUE	G.5.13	LW Anisotropic Model Value
DVALUE	G.5.25	Albedo and Directional Model Value

- The purpose of the “wrap-around” test is to prevent the misclassification of cloud cover as overcast when it should be clear. The implementation of this test is shown in the flowchart for each of the three processing options.

The “Science Reference Manual,” Reference 4, contains additional detail and background on this scene identification technique.

5.2.2.1.1 Linear Interpolation for LW Radiant Exitance (XMNLW). Function XMNLW performs linear interpolation between values of longwave radiant exitance that are stored in the **RELWMN** array (see Table A-6a) for each scene type, ITYPE, according to 18-deg colatitudinal increments. Interpolation is not performed for values within either of the extreme nine degrees on the colatitudinal scale. The interpolation scale is offset by nine degrees, as shown below, so that the calculated value is based on the mean radiant exitances defined at mid-points of the 18-deg intervals.



The flowchart, Figure 5.2-8, describes this process in detail. The variable DELCLT is in the COMMON Block /CONST/.

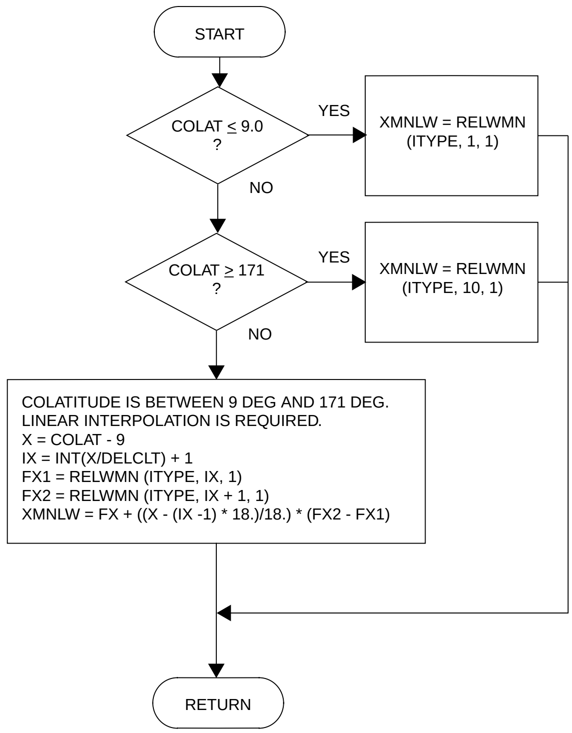


Figure 5.2-8. Flowchart of XMNLW (module 5.2.2.1.1)

5.2.3 EARTH TARGET VALIDATION DATA (ETVOUT)

One of the Inversion Subsystem output products is a scanner validation data set for preselected regions of interest (Earth Target Validation Regions or ETVR). This is the daily Earth Target Validation Data (daily ETVD, ID-13).

If, as individual scanner measurements are processed, an ETVR is encountered, the data shown in Table B-6a is inserted into the **ETVD** array and output to a local file. The one-dimensional region numbers for each ETVR are contained in the array **NETVR** which is dimensioned by NDIM20, the number of these scanner validation regions. Both NETVR (COMMON Block /USPARM/) and NDIM20 (COMMON Block /DIMEN/) are included on the NIPCO1 input file.

Additional information concerning ETVD may be found in Section B.7. Figure 5.2-9 is a flowchart of this subroutine.

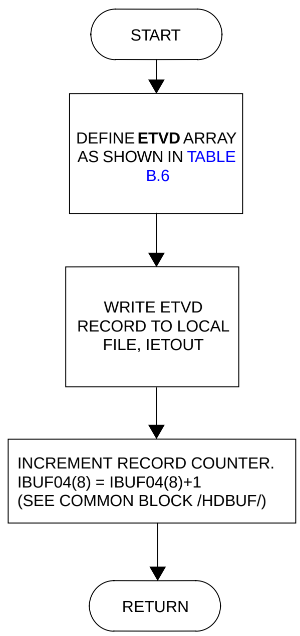


Figure 5.2-9. Flowchart of ETVOUT (module 5.2.3)

5.2.4 SCANNER INVERSION (SCTOA)

The purpose of SCTOA is to estimate the shortwave and longwave radiant exitances at the TOA and to calculate the albedo (see Figure 5.2-10). The estimated shortwave radiant exitance is

$$\hat{M}^{SW} = \pi\, m^{SW}/R$$

where m^{SW} is the unfiltered shortwave measurement and R is the associated shortwave bidirectional model value as determined in subroutine SCNID (#5.2.2.1). The albedo is then calculated from

$$a = \hat{M}^{SW}/(E_o\, l(t)\mu'_0).$$

Notice in the flowchart that two checks are made prior to calculating the shortwave TOA estimate. The first tests the NCASE parameter (see Table 5.2-8) to ensure that a valid unfiltered shortwave measurement may exist. The second checks the flag ISNFLG which is described in Table 5.2-13.

If the first test fails, the locally defined default value of -999. is returned to subroutine SCINV (#5.2) for both the shortwave TOA estimate and the albedo. This negative value serves as a flag in subroutine SCACUM (#5.2.5). No action need be taken in this case for the shortwave TOA estimate going to the **XPAT** array (the PAT* product), since the Merge-FOV Subsystem fills all Inversion Subsystem supplied elements on the pre-PAT (ID-3) with the default value XERROR (see COMMON Block /USPARM).

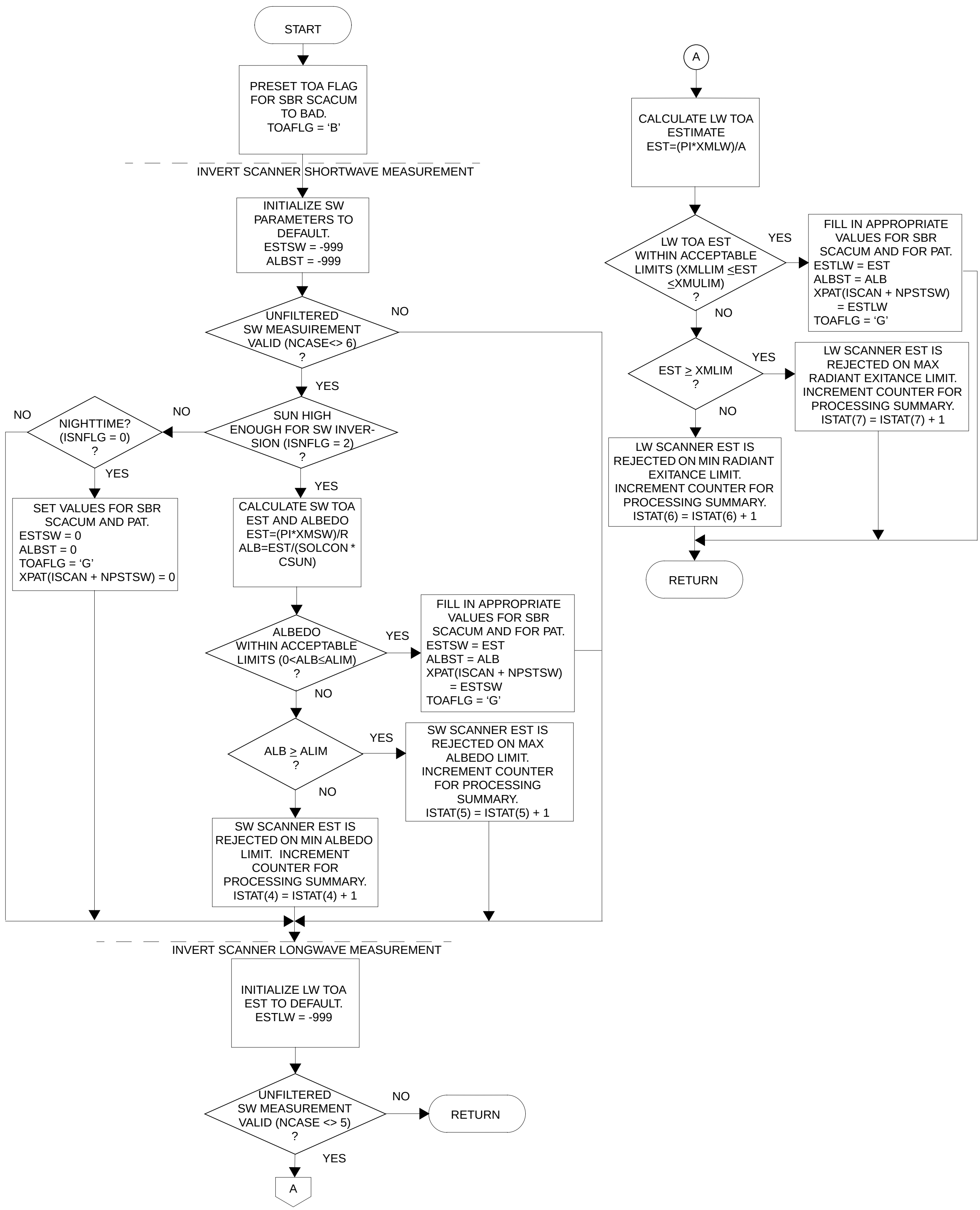


Figure 5.2-10. Flowchart of SCTOA (module 5.2.4)

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Table 5.2-13. The Sun Elevation Flag, ISNFLG

ISNFLG	SOLAR ZENITH (θ'_0)	COMMENT
0	$SZLSID < \theta_0' \leq 180°$	Nighttime
1	$SZLTOA < \theta'_0 \leq SZLSID$	Sun too low for SW data inversion
2	$0° = \theta'_0 \leq SZLTOA$	Sun sufficiently high for SW data inversion
NOTES: 1. ISNFLG is determined in Subroutine SCINV (#5.2). 2. SZLSID and SZLTOA are input from $NAMELIST file NIPCO1 and are contained in COMMON Block /LIMITS/.		

If the second test fails, and it is not nighttime (ISNFLG = 1), the various parameters take on default values as described above. If it is nighttime, these parameters are defined as zero as shown in the flowchart.

If the shortwave TOA estimate and albedo are calculated, a limits check is made on the albedo (0 < a ≤ ALIM, see COMMON Block /LIMITS/). Only if the albedo is within the required constraints are the calculated shortwave values passed on to subroutine SCACUM (#5.2.5) and to PAT*.

The longwave radiant exitance is estimated by

$$\hat{M}^{LW} = \pi m^{LW} / A$$

where m^{LW} is the unfiltered longwave estimate and A is the associated longwave anisotropic model value from subroutine SCNID.

The longwave processing is performed similarly to the shortwave as is shown in the flowchart.

Also notice that the flag TOAFLG (see COMMON Block /FLAG/) is initialized as bad (‘B’) at the beginning of subroutine SCTOA. If either a shortwave or longwave TOA estimate is determined valid, this flag is set to good (‘G’). Subroutine SCACUM (#5.2.5) is not invoked from subroutine SCINV (#5.2) unless this flag is good.

5.2.5 ACCUMULATION OF REGIONAL SCANNER DATA (SCACUM)

This subroutine is responsible for accumulating scanner data from which statistics are calculated for the Daily Data Base Subsystem (ID-6 product).

Scanner data required to calculate the 2.5-deg regional statistics are accumulated in the two arrays **XACT25**, dimensioned NDIM4 by 19, and **IACT25**, dimensioned NDIM4 by 15. These arrays are contained in COMMON Block /ACTREG/. NDIM4 is a parameter included on input file NIPCO1 in NAMELIST $NDIMEN (see Table A-8b). The content of the **XACT25** and **IACT25** arrays is shown in Table 5.2-14. For this routine to be called from subroutine SCINV (#5.2) either the shortwave or longwave or both of these TOA estimates must be good. Therefore, the arrays described in Table 5.2-14 are only updated if subroutine SCTOA (#5.2.4) set TOAFLG = ‘G’. TOAFLG is in COMMON Block /FLAG/.

The row numbers in both arrays are active region indices. The relationship between the active region index, K, and the associated 2.5-deg region is

IACT25(K, 1) = NREG

where

NREG = 144 * (IREG - 1) + JREG

is the one-dimensional region number.

IREG and JREG are the colatitudinal and longitudinal indices, respectively, for the 2.5-deg active region, K, and are calculated as shown in Section G.3.

Individual inverted measurements are grouped as shown in Table 5.2-14 according to their active region index into the appropriate rows of the **XACT25** and **IACT25** arrays.

Regional data are accumulated over the same orbital pass. In the event there is a data dropout such that region NREG is seen before and just after the data dropout, the old active region for NREG must be closed and a new one opened.

Table 5.2-14. Scanner Regional Statistics as Accumulated in the Arrays **XACT25** and **IACT25**

J	IACT25(K, J)	XACT25(K, J)
1	One-dimensional region number	$\Sigma \mathrm{time}(WJD + FJD)$
2	Number of regional updates	$\Sigma \hat{M}^{SW}$
3	Fly-by-flag	$\Sigma(\hat{M}^{SW})^2$
4	Number of clear scenes*	$\Sigma(\mathrm{albedo})$ over clear scenes
5	Number of partly-cloudy scenes*	$\Sigma(\mathrm{albedo})$ over partly-cloudy scenes
6	Number of mostly-cloudy scenes*	$\Sigma(\mathrm{albedo})$ over mostly-cloudy scenes
7	Number of overcast scenes*	$\Sigma(\mathrm{albedo})$ over overcast scenes
8	Number of individual SW estimates	$\Sigma \hat{M}^{LW}$
9	Number of individual LW estimates	$\Sigma(\hat{M}^{LW})^2$
10	Number of LW estimates over clear sky	Minimum SW estimate at TOA
11	Histogram pointer	Maximum SW estimate at TOA
12	Number of clear scenes**	Minimum LW estimate at TOA
13	Number of partly-cloudy scenes**	Maximum LW estimate at TOA
14	Number of mostly-cloudy scenes**	$\Sigma(\mathrm{cosine})$ (solar zenith angle)
15	Number of overcast scenes**	Σ spacecraft zenith angle
16		Σ relative azimuth angle
17		$\Sigma(\mathrm{albedo})^2$ over clear scenes
18		$\Sigma\ \hat{M}^{LW}$ for clear scenes
19		$\Sigma(\hat{M}^{LW})^2$ for clear scenes

* SW, DAYTIME ONLY - used to calculate albedos and scene fractions for the DDB Subsystem.

** SW and LW Combined - used to determine scene fractions for the dynamic scene identification matrix and for output to the DDB Subsystem when the number of SW daytime measurements is zero.

Figure 5.2-11 illustrates the situation where NREG is seen consecutively from two different orbits. Table 5.2-15 shows the value of KFLAG = IACT25(K, 3), the fly-by-flag, as scanner data processing switches between subroutines SCACUM and SCINV each 16 seconds. A similar table, contained in the next section, shows the KFLAG parameter during normal processing (without the data dropout).

The parameter NACT keeps track of the current number of active regions. If NACT > NDIM4, there is no more storage available in the arrays **XACT25** and **IACT25**. This condition results in a fatal error, and processing is terminated.

In addition, SCACUM also controls the accumulation of data for the histogram output product (see subroutine HISTO, #G.5.4).

A flowchart of this subroutine is shown in Figure 5.2-12.

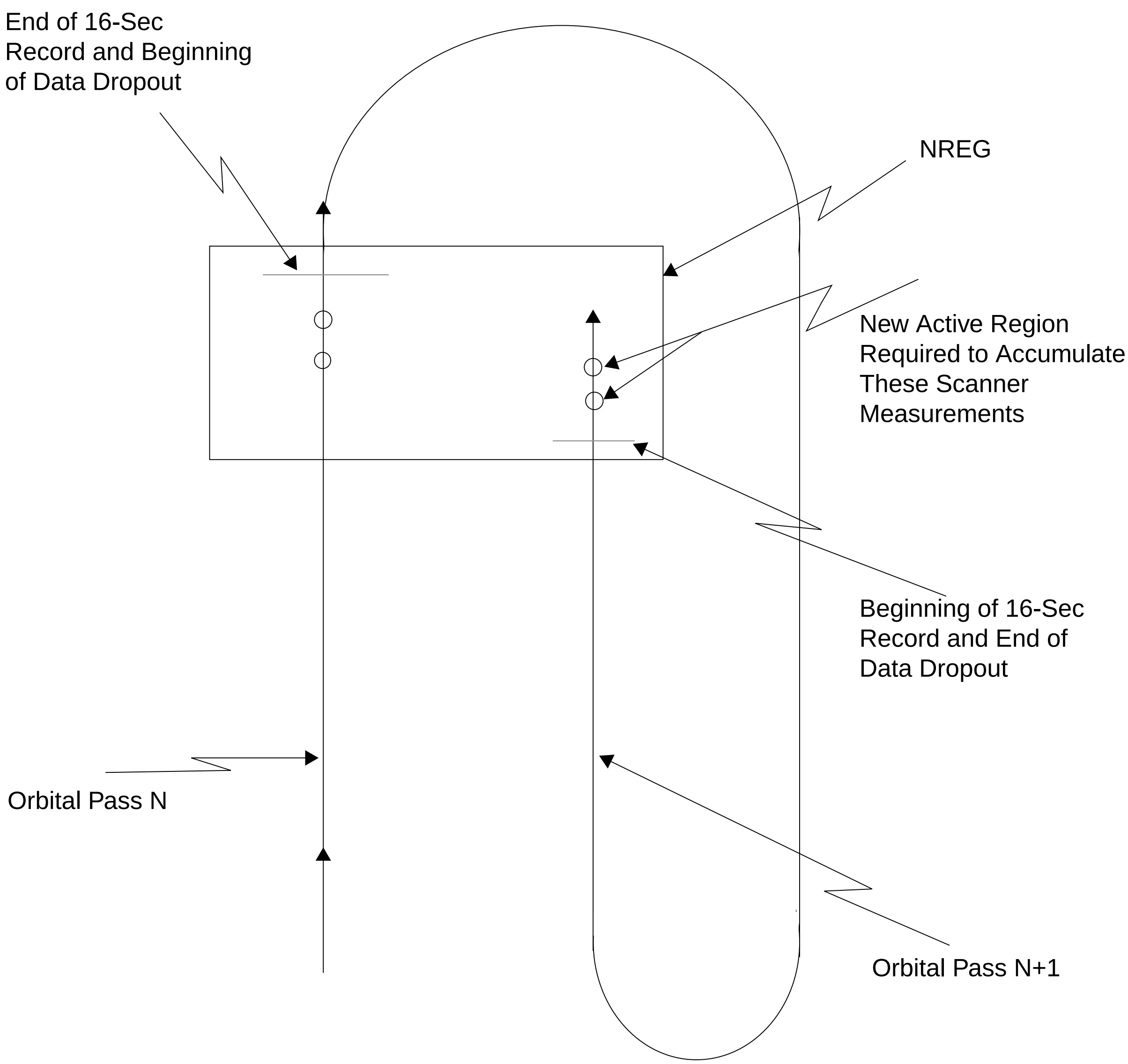


Figure 5.2-11. Opening a Second 2.5-deg Scanner Region

Table 5.2-15. Implementation of the Fly-by-Flag, KFLAG = IACT25(K,3), is Illustrated for a Data Dropout Situation.

CONDITION	ACTION	KFLAG VALUE OLD	KFLAG VALUE NEW	SUBROUTINE
K^{th} active region for NREG is initialized.	KFLAG(K) = 100	100		SCACUM
1st regional update.	KFLAG(K) = KFLAG(K) + 100	200		
KFLAG(K) > 0, K^{th} active region was seen over most recent data time frame.	KFLAG(K) = 0	0		SCFIN
NREG seen during current 16-sec record.				SCACUM
Data Dropout detected such that NREG not previously seen since last orbit.				
Set flag to close K^{th} active region for NREG.	KFLAG(K) = -100	-100		
Initialize new active region for NREG.	KFLAG(K+n) = 100		100	
1st regional update.	KFLAG(K+n) = KFLAG(K+n) + 100		200	
KFLAG(K) = 100 ≤ 1 - NOSEE = -1	K^{th} active region close IACT25 (K,1) = 0			SCFIN
KFLAG(K+n) > 0 $(K+n)^{th}$ active region was seen over most recent data time frame.	KFLAG(K+n) = 0		0	

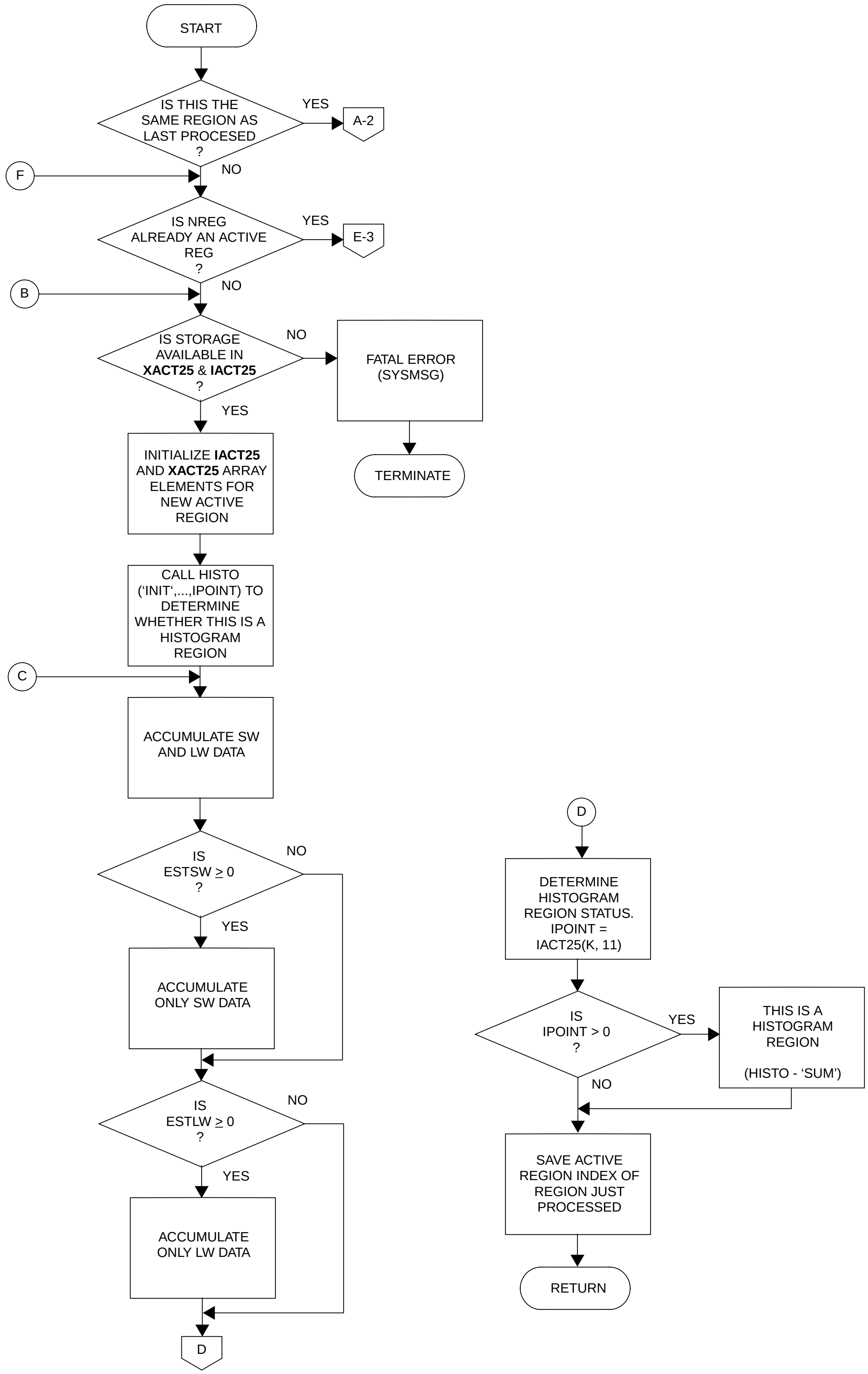


Figure 5.2-12. Flowchart of SCACUM (Module 5.2.5) (1 of 3)

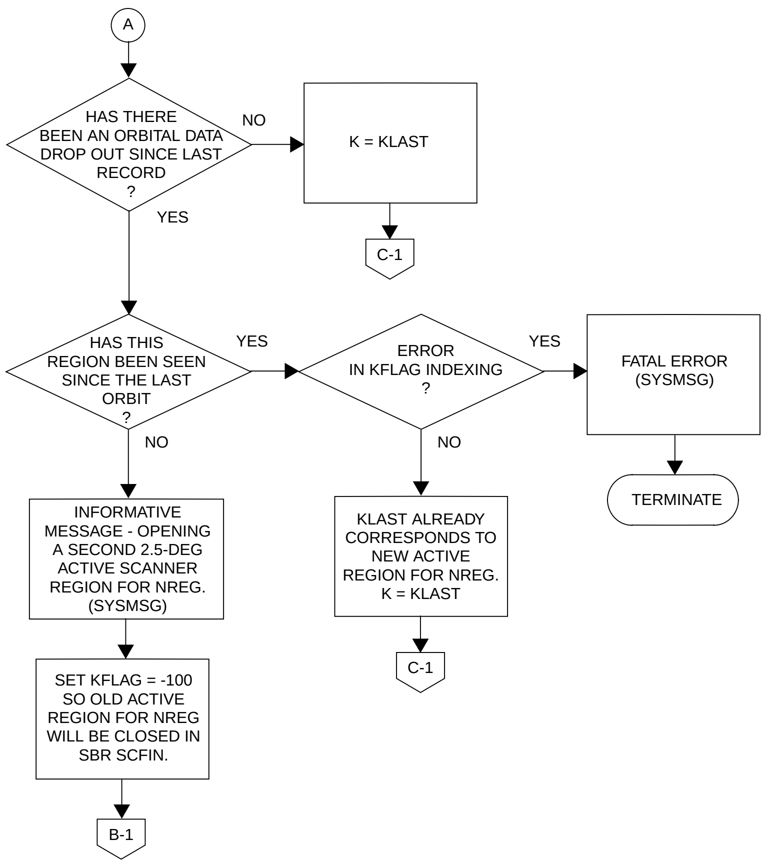


Figure 5.2-12. Flowchart of SCACUM (Module 5.2.5) (2 of 3)

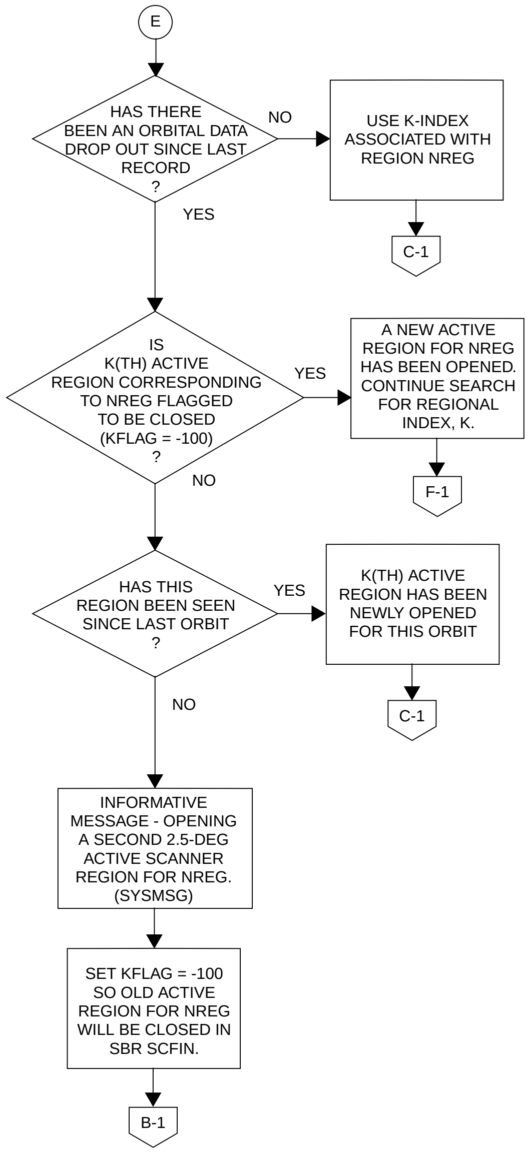


Figure 5.2-12. Flowchart of SCACUM (Module 5.2.5) (3 of 3)

5.2.6 FINALIZE REGIONAL SCANNER DATA (SCFIN)

After scanner data for each data time frame are processed, the status for each currently active region is categorized into one of three designations based on the “fly-by-flag,” IACT25(K, 3).

If the region was not seen by the scanner instrument over two (parameterized as NOSEE, see COMMON Block /USPARM/) consecutive data time frames, it is closed and the following actions are taken.

- A counter for the number of active scanner regions closed is incremented for the processing summary.
- Regional scanner statistics are computed and output to the Daily Data Base Subsystem (see subroutine SCTSA, #G.5.8).
- Data for the histogram product are output if the closed region is a histogram region (see subroutine HISTO, #G.5.4).
- 5-deg and 10-deg scene information is saved if the closed active region is a nadir region (see subroutine NSSCN, #G.5.2) and if the ID-7 product is requested. (See NOTE in Section 5.2.1).
- If the ID-7 product is requested (see NOTE in Section 5.2.1), the dynamic scene identification matrix is updated with the most recent cloud cover information for the active 2.5-deg region being closed. This information is stored in the three-dimensional character array **DYNID**. Recall that the geographic scene type and nominal values for clear sky albedo and longwave radiant exitance are also stored in this array (see Table A-6a). Data are stored in **DYNID** according to the indices IREG, JREG, and KDEX. IREG and JREG are the colatitudinal and longitudinal indices, respectively, for the 2.5-deg region. For each 2.5-deg region, **DYNID** contains seven sets of scene information corresponding to the index KDEX as shown in Table 5.2-16 below.

Table 5.2-16. The 2.5-deg Regional Scene Information Contained in the **DYNID** Array as Specified by the Index KDEX

KDEX	DESCRIPTION	TYPE
1	Clear sky	Dynamic
2	Partly cloudy	Dynamic
3	Mostly cloudy	Dynamic
4	Overcast	Dynamic
5	Geographic scene type	Static
6	Nominal, clear sky, overhead sun albedo	Static
7	Nominal, clear sky, LW radiant exitance	Static

The geographic scene type and nominal, clear sky values are discussed in Section A.4. In updating the dynamic scene identification matrix the **IDYNID** array is used to convert fractional cloud cover to character data as stored in **DYNID**. Table 5.2-17 shows the content of **IDYNID**. The fractional cover for cloud condition KDEX is computed by

$$f_{KDEX} = \frac{REAL[IACT25(K,KDEX+11)]}{SUM}$$

for KDEX = 1, 2, 3, and 4

where

$$SUM = \sum_{KDEX=1}^{4} IACT25(K,KDEX+11)$$

so that

DYNID(IREG, JREG, KDEX) = IDYNID[NINT(10 * f_{KDEX}]

Table 5.2-17. Description of the **IDYNID** Array

IDYELN	IDYNID(IDYELN)	FRACTIONAL COVERAGE
0	'0'	0.0
1	'1'	0.1
2	'2'	0.2
3	'3'	0.3
4	'4'	0.4
5	'5'	0.5
6	'6'	0.6
7	'7'	0.7
8	'8'	0.8
9	'9'	0.9
10	'H'	1.0

To illustrate the procedure of updating the dynamic scene identification matrix, let the fractional cloud covers for clear, partly cloudy, mostly cloudy, and overcast be

$$f_{cr} = 0.13,$$

$$f_{pc} = 0.41,$$

$$f_{mc} = 0.37,$$

and

$$f_{ov} = 0.09,$$

respectively. Then,

DYNID(IREG, JREG, 1) = ‘1’,

DYNID(IREG, JREG, 2) = ‘4’,

DYNID(IREG, JREG, 3) = ‘4’,

and

DYNID(IREG, JREG, 4) = ‘1’.

The recovery of fractional cloud cover is discussed in Section 5.3.1.2.1.

- The K^{th} active region is closed by setting IACT25(K, 1) = 0.

If the K^{th} active region was seen over the most recent data time frame, the fly-by-flag is set to zero. Otherwise, the K^{th} active region was not seen over this data time frame, and the fly-by-flag is decreased by one.

The implementation of the fly-by-flag, KFLAG, between subroutines SCACUM and SCFIN is illustrated in Table 5.2-18 below for the K^{th} active region where NOSEE is two.

After all active regions are examined, if none were closed, control is returned to the calling program. Otherwise, the arrays **XACT25** and **IACT25** are reordered such that rows corresponding to the closed region(s) are filled with active regional data from the bottom rows of **XACT25** and **IACT25**.

A flowchart of this subroutine is shown in Figure 5.2-13.

Table 5.2-18. Implementation of the Fly-by-Flag, KFLAG=IACT25(K,3), is Illustrated

CONDITION	ACTION	VALUE OF KFLAG	SUBROUTINE
K^{th} active region is initialized. 1st regional update. Subsequent updates.	KFLAG = 100 KFLAG = KFLAG + 100 KFLAG = KFLAG + 100	100 200 300	SCACUM
KFLAG > 0, K^{th} active region was seen over most recent data time frame.	KFLAG = 0	0	SCFIN
K^{th} active region was not seen over subsequent data time frame.	None	0	SCACUM
KFLAG ≠ 1 - NOSEE = -1 KFLAG not greater than 0. Therefore, K^{th} active region not seen this data time frame.	 KFLAG = KFLAG - 1	 -1	SCFIN
K^{th} active region not seen over subsequent data time frame.	None	-1	SCACUM
KFLAG = 1-NOSEE = -1	K^{th} active region closed IACT25(K,1) = 0		SCFIN

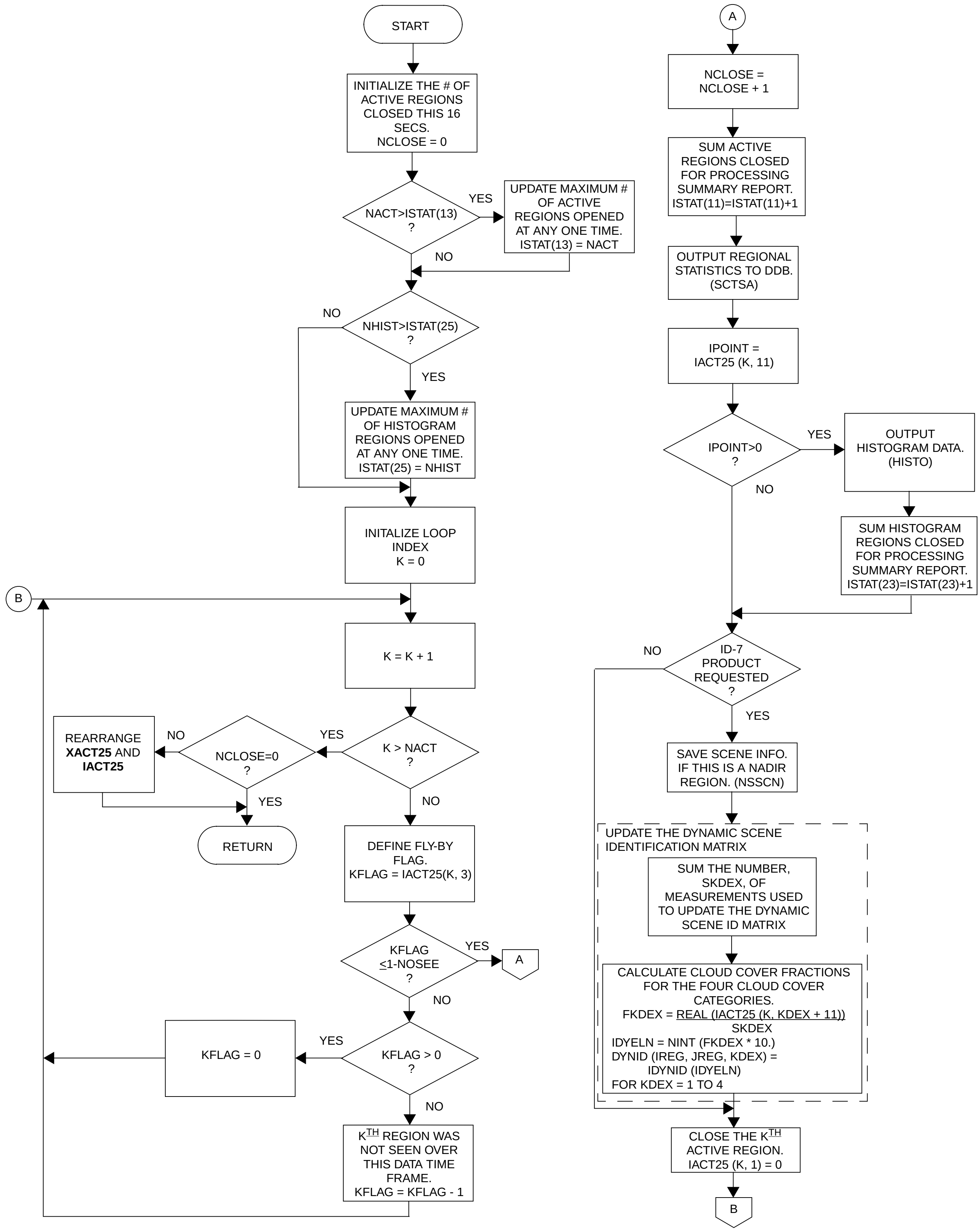


Figure 5.2-13. Flowchart of SCFIN (Module 5.2.6)

5.3 NONSCANNER PROCESSING AND INVERSION (NSINV)

Subroutine NSINV drives the processing of the nonscanner data that has been accumulated over 32-sec intervals and stored in array **XPATNS** (see COMMON Block /NSSET/). There are 20 nonscanner measurement sets per data time frame on the input-PAT. Each of these measurement sets includes radiometric data from a shortwave channel and a total channel for both MFOV and WFOV, as well as the colatitude and longitude of the center of the FOV. The contents of **XPATNS** are derived by accumulating these nonscanner data during scanner data processing (see subroutine RDPAT #5.2.1).

Switching logic is incorporated into scanner processing in order to determine when control is to be passed to the nonscanner driver (NSINV). Control switches to nonscanner processing when one of three events occurs:

- a 32-sec nonscanner measurement is missing,
- the **XPATNS** array is filled to a predetermined limit based on the scanner/nonscanner switching time, TPRD (see COMMON Block /USPARM/),
- an end-of-file is encountered on the input-PAT.

NSINV processes nonscanner data in both a regular (see subroutine NSREG, #5.3.1) and a special (see subroutine NSSPEC, #5.3.2) mode. Regular mode processing is invoked to compute nonscanner TOA estimates by applying the numerical filter technique and the scene dependent shape factor technique. This mode is used only if sufficient measurements are available to calculate the influence coefficients required to implement these algorithms (see N12 in COMMON Block /INTERN/). Special mode processing is invoked to compute nonscanner TOA estimates using the shape factor method only. NSSPEC is called from NSINV under two circumstances. First, if an insufficient number of measurements exist to calculate influence coefficients, NSSPEC is required to calculate TOA estimates for the associated measurements using a scene independent shape factor method (see function SFAC2, #G.5.9.2). NSSPEC is also used, following regular mode processing, if the switch to nonscanner processing is initiated by a data dropout or an end-of-file. Under this circumstance, NSSPEC is invoked to calculate TOA estimates using a shape factor method using influence coefficients (see function SFAC1 (#G.5.9.1) for the six measurements immediately preceding the dropout or end-of-file.

In addition to controlling the nonscanner data processing flow, NSINV is responsible for redefining parameters before returning to scanner data processing. See Figure 5.3-1 for the flowchart of NSINV.

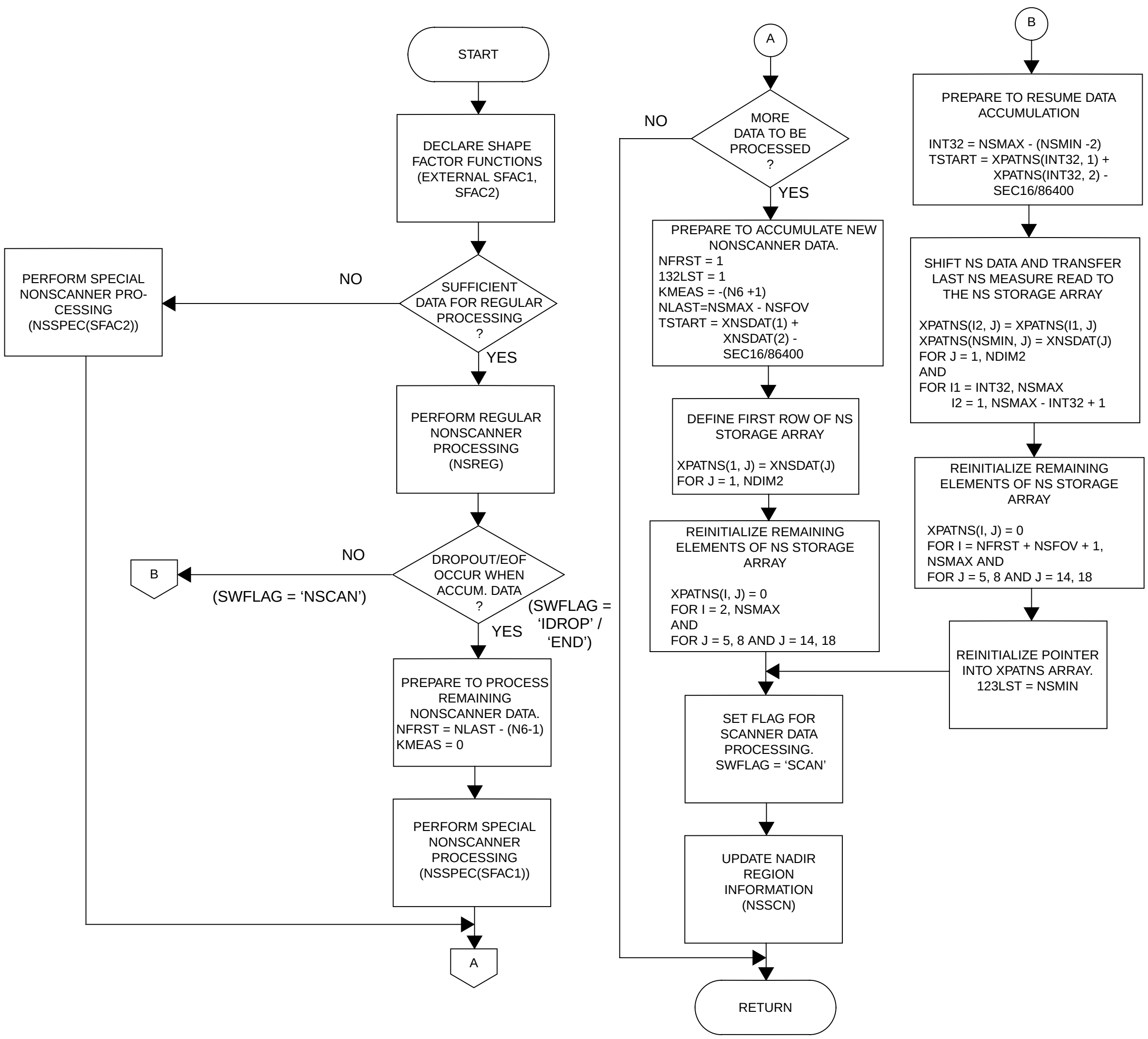


Figure 5.3-1. Flowchart of NSINV (Module 5.3)

5.3.1 NONSCANNER REGULAR PROCESSING MODE (NSREG)

Subroutine NSREG processes continuous nonscanner measurements and calculates radiant exitances at the top of atmosphere by the shape factor and numerical filter algorithms.

In the regular processing mode, individual nonscanner measurements accumulated in the **XPATNS** array over 32 seconds are averaged, and the elements of the transformation matrix, **ATRAN**, are computed (see subroutine DATNS, #5.3.1.1). Also, for each average measurement, a set of influence coefficients is calculated (see subroutine INFLCO, #5.3.1.2).

In order to invert the Nth nonscanner measurement by the numerical filter algorithm (see subroutine INVNF, #5.33.1.3), the influence coefficients for measurements N - 6 through N + 6 must be available. However, when using the shape factor algorithm (see subroutine INVSF, #G.5.9), only the influence coefficients associated with the N^{th} measurement need be known.

The technique developed to implement these two inversion methods requires that the first six measurements be processed and inverted by the shape factor algorithm only. For subsequent measurements, data is inverted only after 13 sets of influence coefficients, as required by the numerical filter method, have been calculated. For example, as the Nth measurement set (N > 12) is processed, the $(N - 6)^{th}$ measurement is inverted by both the shape factor and numerical filter algorithms.

Regular nonscanner data processing continues until TOA estimates are calculated for all but the final six measurements in **XPATNS** and the influence coefficients have been calculated for all measurements. In the event that the switch to nonscanner processing is the result of a data dropout or end-of-file, the TOA estimates for the final six measurements will be determined upon return to subroutine NSINV, the nonscanner driver, using the influence coefficients already calculated in NSREG.

An example showing nonscanner processing flow is shown in Figure 5.3-2. In this illustration the first 29 rows (corresponding to 29 32-sec time intervals) of the **XPATNS** array were filled during scanner data processing. The next data time frame fell into 32-sec time interval 35, and so the SWFLAG parameter was set to ‘IDROP’.

After estimates of the radiant exitance at the TOA have been found, nonscanner data required by the Daily Data Base Subsystem are calculated and output to the ID-7 product (see subroutine NSTSA, #G.5.10). The ID-7 is required by the Inversion Subsystem Post-Processor if nonscanner TOA data and Inversion Subsystem supplied nonscanner data flags are to be provided on the PAT60 (see related NOTE in Section 5.2.1).

A flowchart of subroutine NSREG is shown in Figure 5.3-3.

<table>
<tr><th rowspan="2">N</th><th colspan="3">NONSCANNER PROCESSING DESCRIPTION</th></tr>
<tr><th colspan="2">REGULAR MODE</th><th>SPECIAL MODE</th></tr>
<tr><td>1
2
3
4
5
6</td><td rowspan="4">Calculate
Influence
Coefficients
for N^{th}
Time Interval</td><td>Invert N^{th} Measurement
by the
Shape Factor Algorithm</td><td rowspan="3"></td></tr>
<tr><td>7
8
9
10
11
12</td><td>No Inversion</td></tr>
<tr><td>13
14
15
16
17
18
19
20
21
22
23</td><td>Invert the $(N-6)^{th}$
Measurement
by the
Shape Factor
and the
Numerical Filter
Algorithms</td></tr>
<tr><td>24
25
26
27
28
29</td><td>No Inversion</td><td>Invert N^{th}
Measurement
by the
Shape Factor
Algorithm</td></tr>
<tr><td>•
•
•</td><td colspan="3">← Time Intervals 30-34 are physically missing from pre-PAT</td></tr>
<tr><td>35</td><td colspan="3">← Becomes N=1 on next pass through Nonscanner Processing</td></tr>
</table>

Figure 5.3-2. Hypothetical Illustration of Nonscanner Data Processing for the Nth 32-sec Time Interval

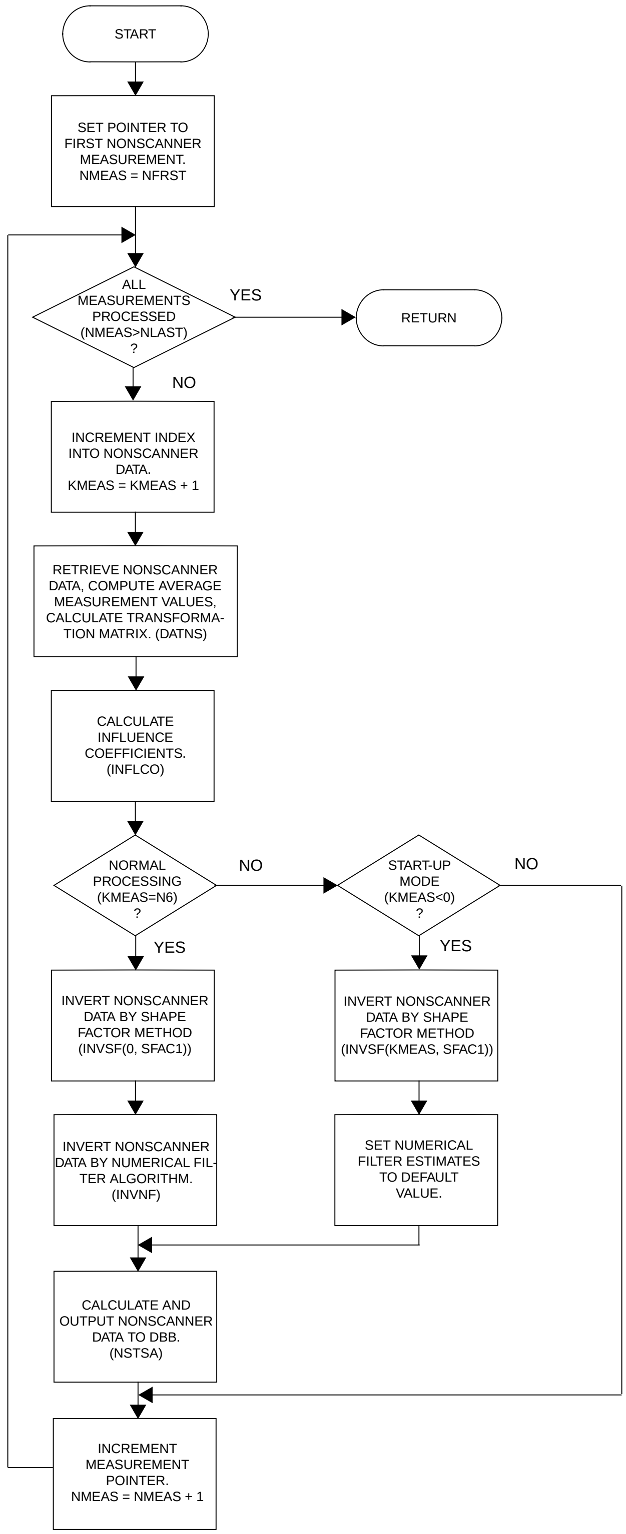


Figure 5.3-3. Flowchart of NSREG (Module 5.3.1)

5.3.1.1 Define 32-Second Average Measurements and Calculate Coordinate Transformation Matrix (DATNS). Subroutine DATNS retrieves nonscanner data from the **XPATNS** array for the current 32-sec time interval and computes the nonscanner average measurement values (see **XPATNS** in COMMON Block /NSSET/). Additionally, DATNS computes the transformation matrix **ATRAN**, determines the unit position of the sun in the ground track coordinate system, and computes the regional indices associated with the 2.5-deg nadir region.

Nonscanner data inversion calculations are performed in a dynamic right-hand orthogonal coordinate system aligned with the spacecraft orbit such that the z-axis is in the direction of the spacecraft angular momentum vector. The positions of a sequence of 13 consecutive 32-sec average measurements define the xy-plane. The x-axis passes through the center of the 13 measurements.

It is necessary that certain coordinates in the fixed Earth equatorial-Greenwich system be known in this ground track (or spacecraft aligned) coordinate system. Subroutine AXTRAN (#5.3.1.1.1) is invoked to calculate the Euler transformation matrix, **ATRAN**, based on inputs in DATNS. This transformation is defined such that

$$\mathbf{RG} = \mathbf{ATRAN} * \mathbf{R}$$

where **RG** is a coordinate vector in the ground track coordinate system, and **R** is a coordinate vector in the Earth equatorial-Greenwich coordinate system.

Inversion of the ith measurement by a degree n numerical filter requires information associated with measurements i - n through i + n. Before each new nonscanner measurement is inverted, the arrays containing this information must be updated. This is accomplished in subroutine DSHIFT (#5.3.1.1.2).

For a flowchart of subroutine DATNS, see Figure 5.3-4.

It should be noted that the following convention has been adopted so that the nonscanner inversion routines can distinguish between no data and radiometric measurements of zero. Average nonscanner measurements are calculated by

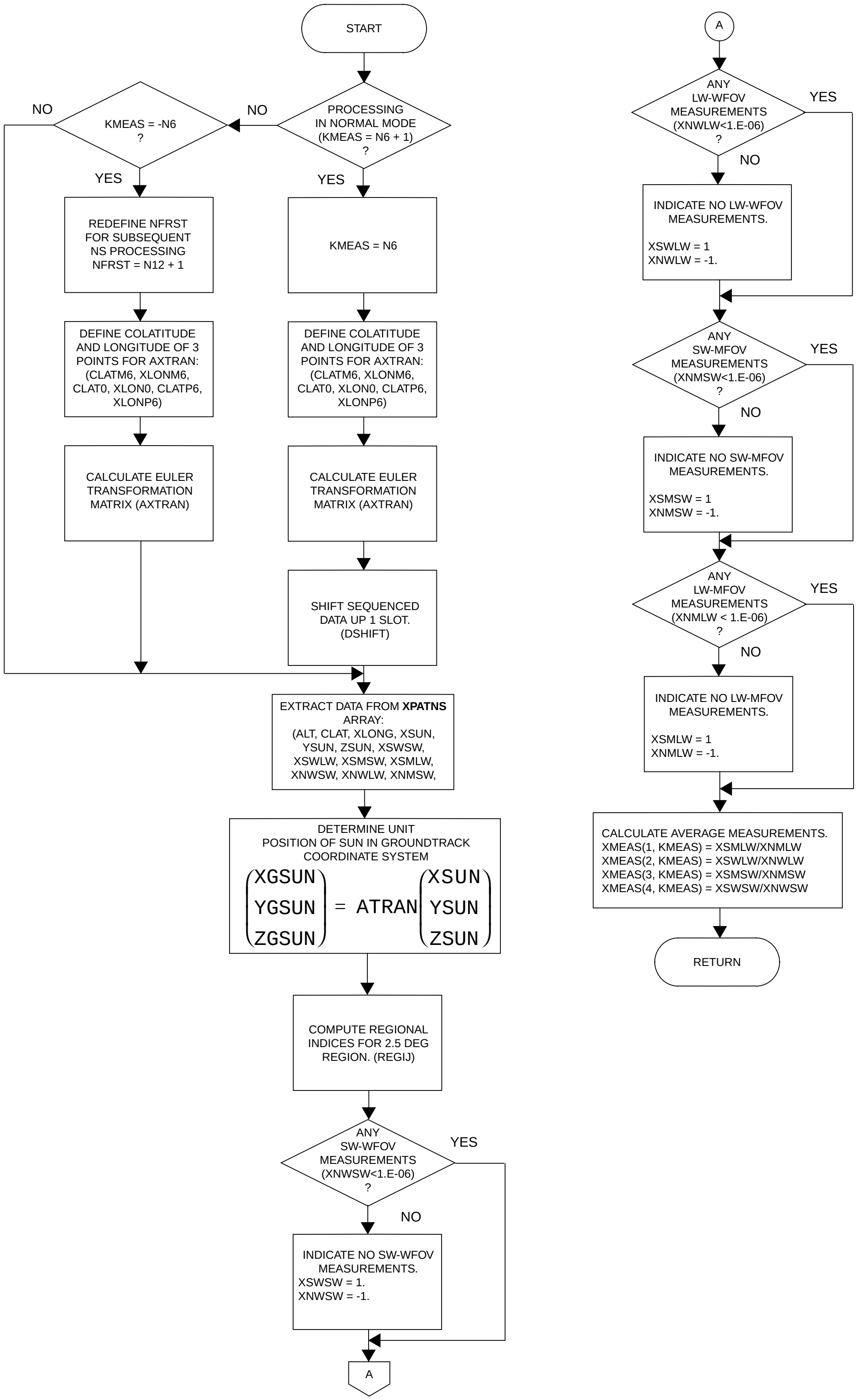


Figure 5.3-4. Flowchart of DATNS (Module 5.3.1.1)

$$\text{average measurement} = \frac{1}{n}\sum_{i=1}^{n}(\text{individual measurement})_i,$$

where n is the number of nonscanner measurements of some type (WFOV-SW, MFOV-LW, etc.) available over the 32-sec averaging period $(0 \le n \le 40)$. If n = 0, then n is set equal to -1, and $\Sigma(\text{individual measurement})_i$ is set equal to 1, so that

average measurement = -1, implies that no data is available

and

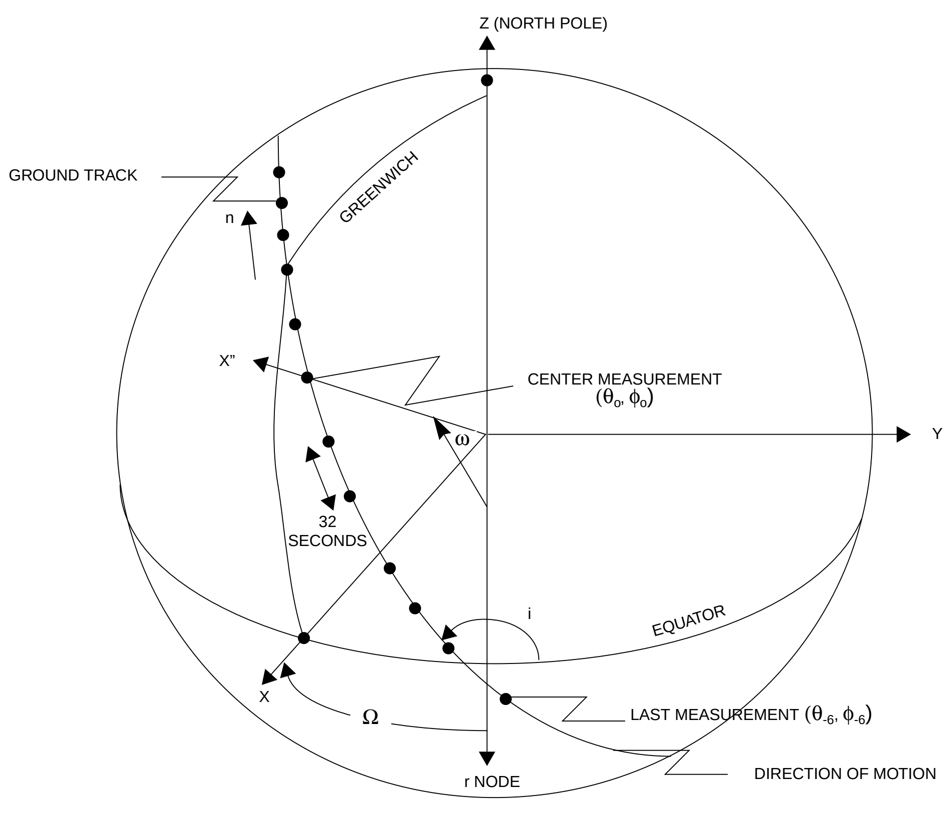
average measurement = 0, implies a zero measurement.

5.3.1.1.1 Calculate the Euler Transformation Matrix (AXTRAN). Subroutine AXTRAN calculates the Euler transformation matrix, **ATRAN**, that is used to translate measurements from the equatorial coordinate system to the ground track coordinate system (see **ATRAN** in COMMON Block /VAR/).

The Euler transformation matrix required by the nonscanner processing algorithm is

$$\mathbf{ATRAN} = \begin{bmatrix} \cos\omega\ \cos\Omega - \cos i\ \sin\Omega\ \sin\omega & \cos\omega\ \sin\Omega + \cos i\ \cos\Omega\ \sin\omega & \sin\omega\ \sin i \\ -\sin\omega\ \cos\Omega - \cos i\ \sin\Omega\ \cos\omega & -\sin\omega\ \sin\Omega + \cos i\ \cos\Omega\ \cos\omega & \cos\omega\ \sin i \\ \sin i\ \sin\Omega & -\sin i\ \cos\Omega & \cos i \end{bmatrix}$$

The angles ω, Ω, and i are shown in the figure below.



The **ATRAN** matrix is calculated in terms of the subsatellite points at (θ_{-6}, ϕ_{-6}), (θ_0, ϕ_0), and (θ_6, ϕ_6). The spacecraft unit vectors associated with these three sets of position coordinates are $\hat{r}_{-6}$, $\hat{r}_0$, and $\hat{r}_6$. These unit vectors may be written in terms of their individual components as

$$x_n' = \sin\theta_n \cos\phi_n \quad ,$$

$$y_n' = \sin\theta_n \sin\phi_n \quad ,$$

and

$$z_n' = \cos\phi_n \, .$$

Now define the vector **C** perpendicular to the x″y″-plane containing $\hat{r}_{-6}$ and $\hat{r}_6$, such that

$$\mathbf{C} = \hat{r}_{-6} \times \hat{r}_6 \, ,$$

or

$$C_x = y'_{-6}z'_6 - z'_{-6}y'_6 \, ,$$

$$C_y = z'_{-6}x'_6 - x'_{-6}z'_6 \, ,$$

$$C_z = x'_{-6}y'_6 - y'_{-6}x'_6 \, ,$$

then

$$C_x = \sin\theta_{-6}\sin\phi_{-6}\cos\theta_6 - \cos\theta_{-6}\sin\theta_6\sin\phi_6 \; ,$$

$$C_y = \cos\theta_{-6}\sin\theta_6\cos\phi_6 - \sin\theta_{-6}\cos\phi_{-6}\cos\theta_6 \; ,$$

and

$$C_z = \sin\theta_{-6}\cos\phi_{-6}\sin\theta_6\sin\phi_6 - \sin\theta_{-6}\sin\phi_{-6}\sin\theta_6\cos\phi_6 \; .$$

The components of the unit vector $\hat{c}$ may be written as

$$c_x' = \frac{c_x}{c},$$

$$c_y' = \frac{c_y}{c},$$

and

$$c_z' = \frac{c_z}{c},$$

where

$$C = |\mathbf{C}| = (C_x^2 + C_y^2 + C_z^2)^{1/2} .$$

The unit vector $\hat{c}$ can be represented in the x″y″z″ coordinate system as

$$\hat{c}'' = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix},$$

so that

$$\hat{c} = \mathbf{ATRAN}^{-1}\hat{c}''$$

gives

$$\hat{c} = \begin{bmatrix} \sin\ i\ \sin\Omega \\ -\sin\ i\ \cos\Omega \\ \cos\ i \end{bmatrix} .$$

From this equation it can be seen that

$$\sin\ \Omega = \frac{c_x'}{\sin i},$$

$$\cos\ \Omega = -\frac{c_y'}{\sin i},$$

and

$$\cos\ i = c_z',$$

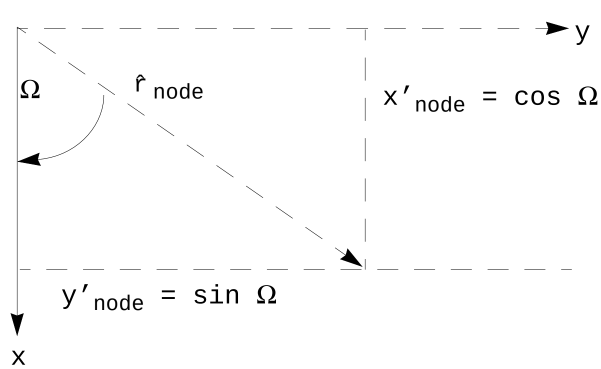
where expressions for c_x', c_y', and c_z' are given above, and

$$\sin\ i = (1 - \cos^2 i)^{1/2}\ .$$

In order to determine $\sin\ \omega$ and $\cos\ \omega$, define the vector **P**, such that

$$\mathbf{P} = \hat{r}_{node} \times \hat{r}_o\ .$$

As shown in the figure below,



$$\hat{r}_{node} = \begin{bmatrix} \cos\ \Omega \\ \sin\ \Omega \\ 0 \end{bmatrix},$$

so that

$$\mathbf{P} = \begin{bmatrix} y'_{node}\ z'_o - z'_{node}\ y'_o \\ z'_{node}\ x'_o - x'_{node}\ z'_o \\ x'_{node}\ y'_o - y'_{node}\ x'_o \end{bmatrix},$$

or **P**

$$\mathbf{P} = \begin{bmatrix} \sin\Omega\ \cos\theta_o \\ -\cos\Omega\ \cos\theta_o \\ \cos\Omega\ \sin\theta_o\ \sin\phi_o - \sin\Omega\ \sin\theta_o\ \cos\phi_o \end{bmatrix}.$$

Now,

$$P = \mathbf{P} \cdot \hat{c} = P_x c'_x + P_y c'_y + P_z c'_z .$$

Also,

$$\mathbf{P} = \hat{z}'' \sin\ \omega$$

and

$$P = |\mathbf{P}| = \sin\ \omega .$$

So,

$$\sin\ \omega = P_x c'_x + P_y c'_y + P_z c'_z .$$

Finally,

$$\hat{r}_{node} \cdot \hat{r}_o = \cos\ \omega ,$$

or

$$\cos\ \omega = x'_{node} x'_o + y'_{node} y'_o + z'_{node} z'_o ,$$

and

$$\cos\ \omega = \cos\Omega\ \sin\theta_o\ \cos\phi_o + \sin\Omega\ \sin\theta_o\ \sin\phi_o .$$

5.3.1.1.2 Shift Elements of Sequenced Data Arrays (DSHIFT). Inversion of the ith nonscanner measurement by an nth degree numerical filter requires information associated with measurements i - n through i + n. This information is contained in the arrays **CDOO**, **CSUNOO**, **XMEAS**, and **BMATRX** which are contained in the /NSMEAS/ COMMON Block. Once these arrays are initially filled, the sequenced data associated with the dimensional index KMEAS (see COMMON Block /VAR/) must be updated or shifted so that as nonscanner processing continues, the data for the ith measurement is stored at KMEAS = 0. Subroutine DSHIFT is responsible for shifting the required elements of the sequenced data arrays. Figure 5.3-5 contains the flowchart of subroutine DSHIFT.

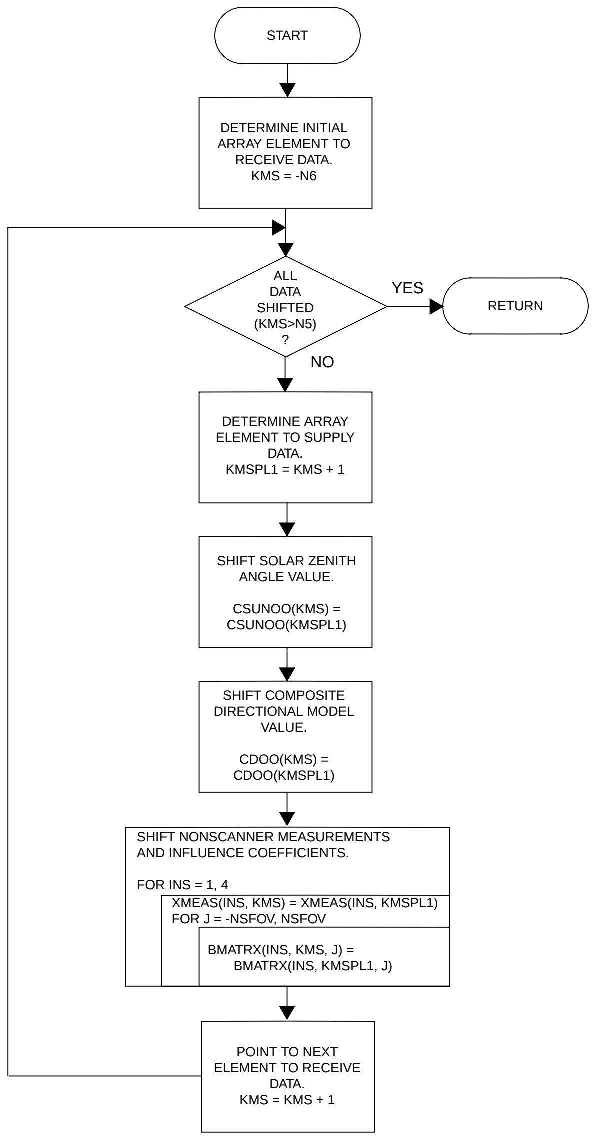


Figure 5.3-5. Flowchart of DSHIFT (Module 5.3.1.1.2)

5.3.1.2 Calculation of Influence Coefficients (INFLCO). Subroutine INFLCO calculates the influence coefficients required by the scene dependent nonscanner inversion algorithms. During regular nonscanner processing (see subroutine NSREG, #5.3.1), estimates of the radiant exitance at the TOA are calculated based on the measurement index KMEAS which ranges from -N6 to N6. N6 is the degree of the numerical filter. In order to perform numerical filter inversion there must be a set of 2 * NSFOV + 1 influence coefficients for each value of KMEAS, where NSFOV is the number of strips a WFOV measurement sees in the forward direction (see N6, NSFOV in COMMON Block /CONST/, KMEAS in COMMON Block /VAR/).

INFLCO calculates these influence coefficients and stores them in the 3-dimensional array **BMATRX**. For example, the MFOV influence coefficient associated with the KMEASth shortwave measurement and the JSTRIPth strip corresponding to this FOV is located in BMATRX(3,KMEAS,JSTRIP). The **BMATRX** is contained in the COMMON Block /NSMEAS/.

In order to find these influence coefficients, subroutine INFLCO iterates through each ij-region (see Figure A-1) associated with the WFOV centered on the KMEASth measurement. For each of these sub-regions the following operations are performed:

- Calculation of the three directional angles required to find the influence coefficients, namely, the solar zenith angle, the spacecraft zenith angle, and the relative azimuth angle (see subroutine ANGCAL, #G.5.7),

- Calculation of the scene fractions needed to determine composite model values (see subroutine SCNFRC, #5.3.1.2.1),

- Calculation of the composite bidirectional shortwave factor, CRIJ, the composite albedo directional model value, CDIJ, and the composite anisotropic longwave factor, CAIJ (see subroutine COMPOS, #5.3.1.2.2),

- Determination of the MFOV and WFOV quadrature weights from the **QMFOV** and **QWFOV** arrays, respectively. Recall, for circular orbits these arrays are calculated in subroutine PARINT (#5.1.2). For elliptical orbits they are calculated here by a call to subroutine QUAD, #G.5.5.

The influence coefficients associated with each strip are found by summing the sub-regional contributions for each strip contained in the FOV centered about the KMEASth measurement. The total number of sub-regions in a strip is 2 * ILIMIT(I) + 1 where ILIMIT(I) contains the number of regions in the top or bottom half of a strip, and is a function of the strip offset from the center of FOV. See Table 5.3-1 for the contents of the **ILIMIT** array.

The longwave and shortwave influence coefficients for the jth strip are given by

$$\gamma_j^{LW} = \sum_{i = I1}^{I2} A_{ij}\gamma_{ij}$$

and

$$\gamma_j^{SW} = E_o\, l(t) \sum_{i = I1}^{I2} (\cos\theta'_o)_{ij} R_{ij}\gamma_{ij}\delta_{ij}$$

where A_{ij} is the composite anisotropic longwave factor, R_{ij} is the composite bidirectional shortwave factor, δ_{ij} is the composite albedo directional model value, $(\cos\theta_o')_{ij}$ is the cosine of the solar zenith angle with respect to the ij-region, and γ_{ij} is the quadrature weight for the sub-region. I1 and I2 are derived from the contents of the **ILIMIT** array, as shown in Figure 5.3-6. These expressions can be used for both MFOV and WFOV since quadrature weight values that fall outside of the MFOV have been set equal to zero.

Table 5.3-1. Content of **ILIMIT** Array

I	Content of ILIMIT(I)		
	NOAA 9	ERBS	NOAA 10
0	6	5	6
1	6	5	6
2	6	5	6
3	6	5	6
4	6	5	6
5	6	5	6
6	6	5	6
7	6	4	6
8	6	4	6
9	6	3	6
10	5	3	5
11	5	2	5
12	4	0	4
13	3	0	3

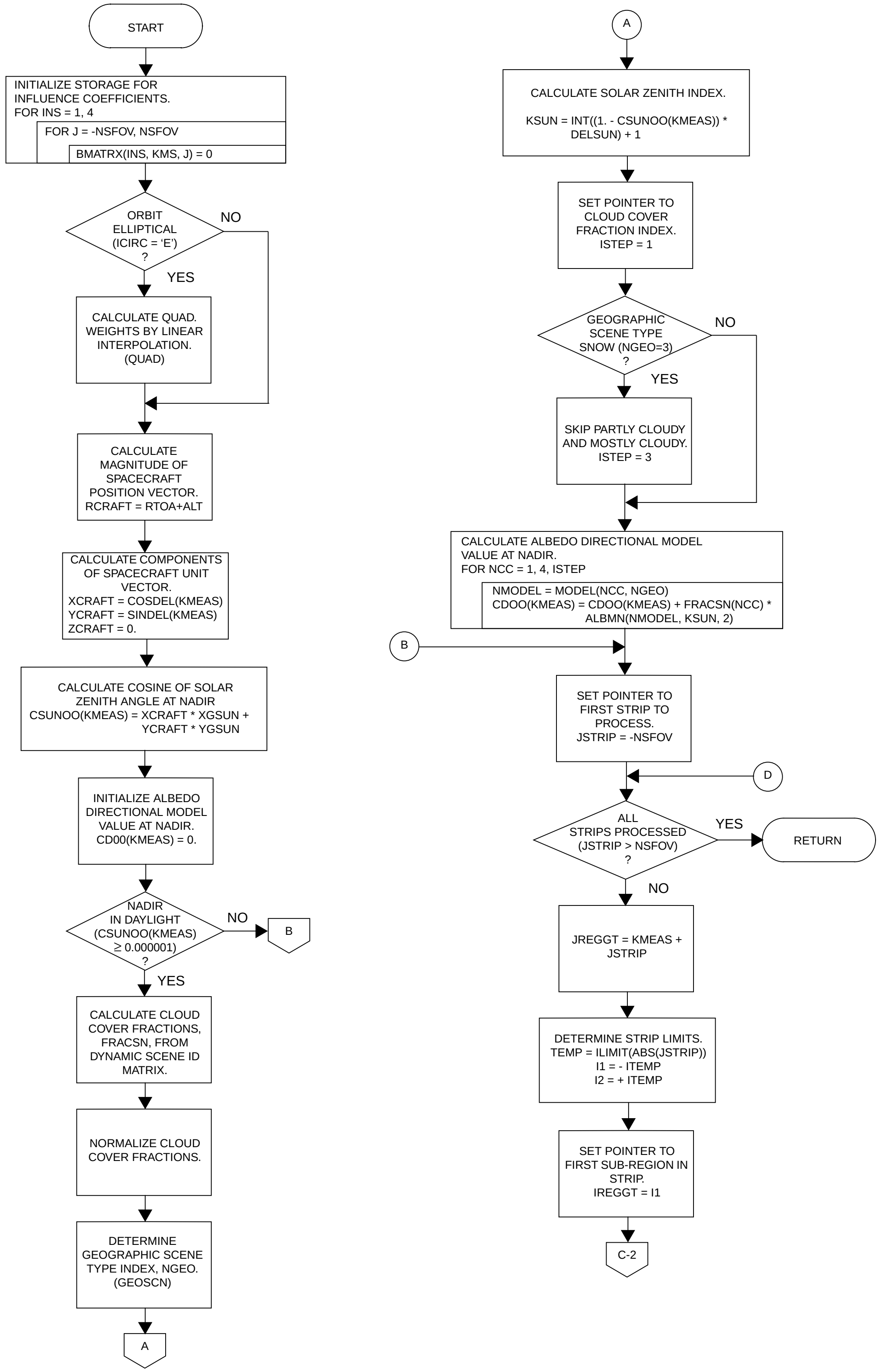


Figure 5.3-6. Flowchart of INFLCO (Module 5.3.1.2) (1 of 2)

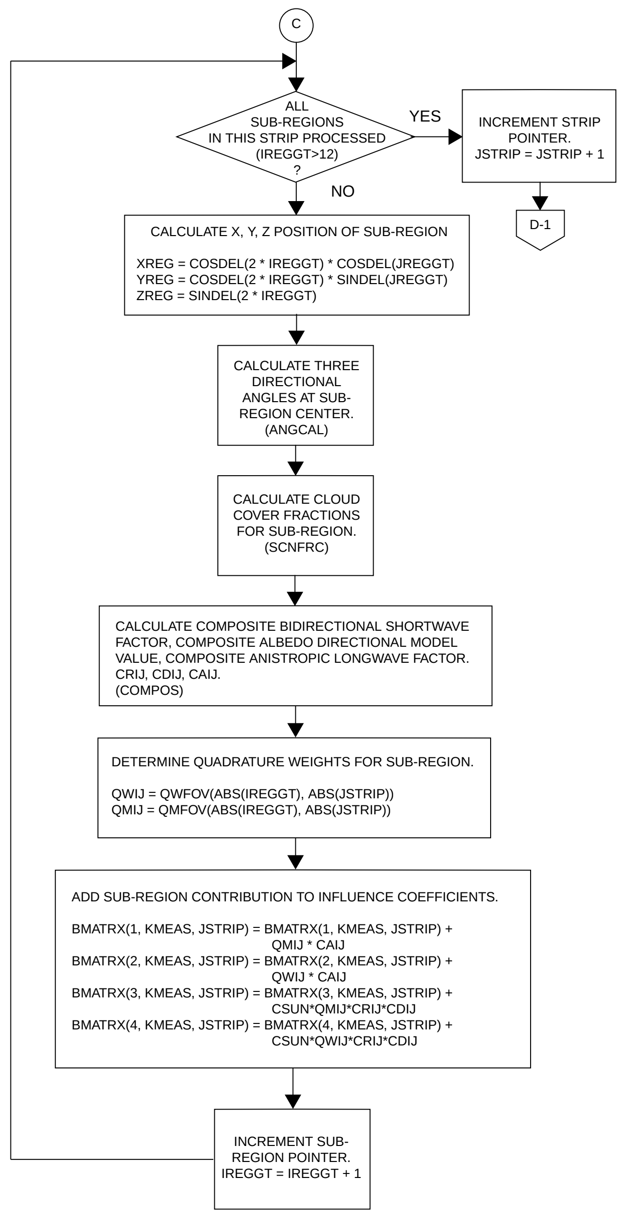


Figure 5.3-6. Flowchart of INFLCO (Module 5.3.1.2) (2 of 2)

Note that the actual implementation of the shortwave influence coefficient calculations (see flowchart of INFLCO in Figure 5.3-6) does not include the corrected solar constant term, $E_o l(t)$, since it would subsequently be divided out when inverted estimates are calculated.

In addition to calculating the four sets of influence coefficients for the KMEASth measurement, subroutine INFLCO also computes the arrays **CSUNOO** and **CDOO** to be used later in the nonscanner data inversion process. CSUNOO(KMEAS) contains the cosine of the solar zenith angle, and CDOO (KMEAS) contains the composite directional model value for the KMEASth measurement.

5.3.1.2.1 Calculate Scene Fractions (SCNFRC). Subroutine SCNFRC calculates the cloud cover fractions based on the contents of the dynamic scene identification matrix for a specified point in the ground track coordinate system. The fractional scene types must be determined for the region associated with the point defined by the coordinate vector $\mathbf{r}_t$ in the ground track coordinate system. The components of the unit vector

$$\hat{r}_t = \frac{\mathbf{r}_t}{r_t}$$

are x'_t, y'_t, and z'_t. The dynamic scene identification matrix contains scene information in terms of colatitude, θ, and longitude, ϕ, in the Earth equatorial-Greenwich coordinate system. This location can be found from

$$\theta = \cos^{-1}(z'_e/R)$$

and

$$\phi = \tan^{-1}(y'_e/x'_e)$$

where

$$\begin{bmatrix} x'_e \\ y'_e \\ z'_e \end{bmatrix} = \mathbf{ATRAN} \begin{bmatrix} x'_t \\ y'_t \\ z'_t \end{bmatrix}$$

are the point’s coordinates in the Earth equatorial-Greenwich system, and

$$R = (x'^2_e + y'^2_e + z'^2_e)^{1/2} .$$

The colatitudinal and longitudinal indices, IREG and JREG, are found by subroutine REGIJ (#G.5.3).

The scene fractions are stored in the **DYNID** array in character format for clear, partly cloudy, mostly cloudy, and overcast cloud cover conditions (see Table 5.2-16). To determine the decimal fractions, the array **IDYNID** is required (see Table 5.2-17). For the indices IREG and JREG, DYNID(IREG, JREG, NCC) is compared with IDYNID(IDYELN) for IDYELN = 0 through 10. If

$$DYNID(IREG,JREG,NCC) = IDYNID(IDYELN),$$

then

$$f'_{NCC} = IDYELN/10.$$

This procedure is repeated for NCC = 1 through 4. If no match is found for any of the four cloud covers, a fatal error message is generated. Otherwise, a set of normalized scene fractions are calculated as shown below:

$$S = \sum_{NCC=1}^{4} f'_{NCC}$$

and

$$f_{NCC} = f'_{NCC}/S$$

for NCC = 1 through 4. The flowchart for subroutine SCNFRC is shown in Figure 5.3-7.

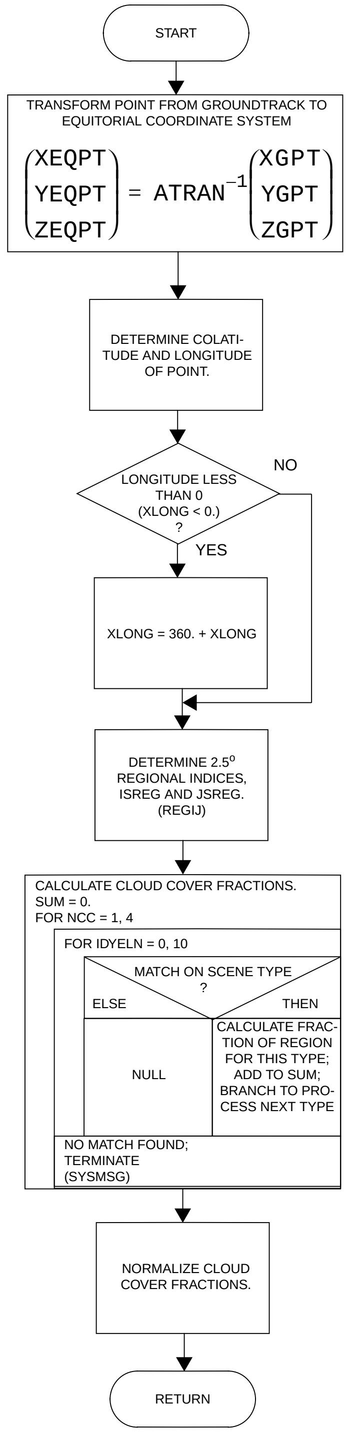


Figure 5.3-7. Flowchart of SCNFRC (Module 5.3.1.2.1)

5.3.1.2.2 Calculate Composite Model Values (COMPOS). Subroutine COMPOS calculates the composite values for the albedo directional model (CDIJ), the shortwave bidirectional model (CRIJ), and the longwave anisotropic model, (CAIJ), according to the following equations:

$$CDIJ = \sum_{NCC=1}^{4} f_{NCC} * ALBMN(NMODEL,KSUN,2),$$

$$CRIJ = \frac{\sum_{NCC=1}^{4} f_{NCC} * ALBMN(NMODEL,KSUN,2) \times RMATRX(NMODEL,KSUN,KZEN,KAZ,1)}{CDIJ},$$

and

$$CAIJ = \sum_{NCC=1}^{4} f_{NCC} * AMATRX(NMODEL,KZEN,KCOLAT,1).$$

The scene fractions, f_{NCC},are computed in subroutine SCNFRC (#5.3.1.2.1) and passed as an input parameter to COMPOS. The arrays **ALBMN**, **RMATRX**, and **AMATRX** contain values for the albedo directional model, the shortwave bidirectional model, and the longwave anisotropic model, respectively (see Table A-6a). The scene ID model number, NMODEL, is determined as follows. First, the geographic scene index NGEO, is obtained from an array containing predetermined geographic scene types (see subroutine GEOSCN, #G.5.6), given the regional indices IREG and JREG of the point for which composite model values are being calculated. Then, for each value of NCC,

NMODEL = **MODEL**(NCC,NGEO).

The **MODEL** array is input with the scene identification algorithm parameters (Table A-6a) and is illustrated in Table 5.2-12. Angular indices KSUN, KZEN, KAZ and KCOLAT are described in Table 5.2-11. For a flowchart of subroutine COMPOS, see Figure 5.3-8.

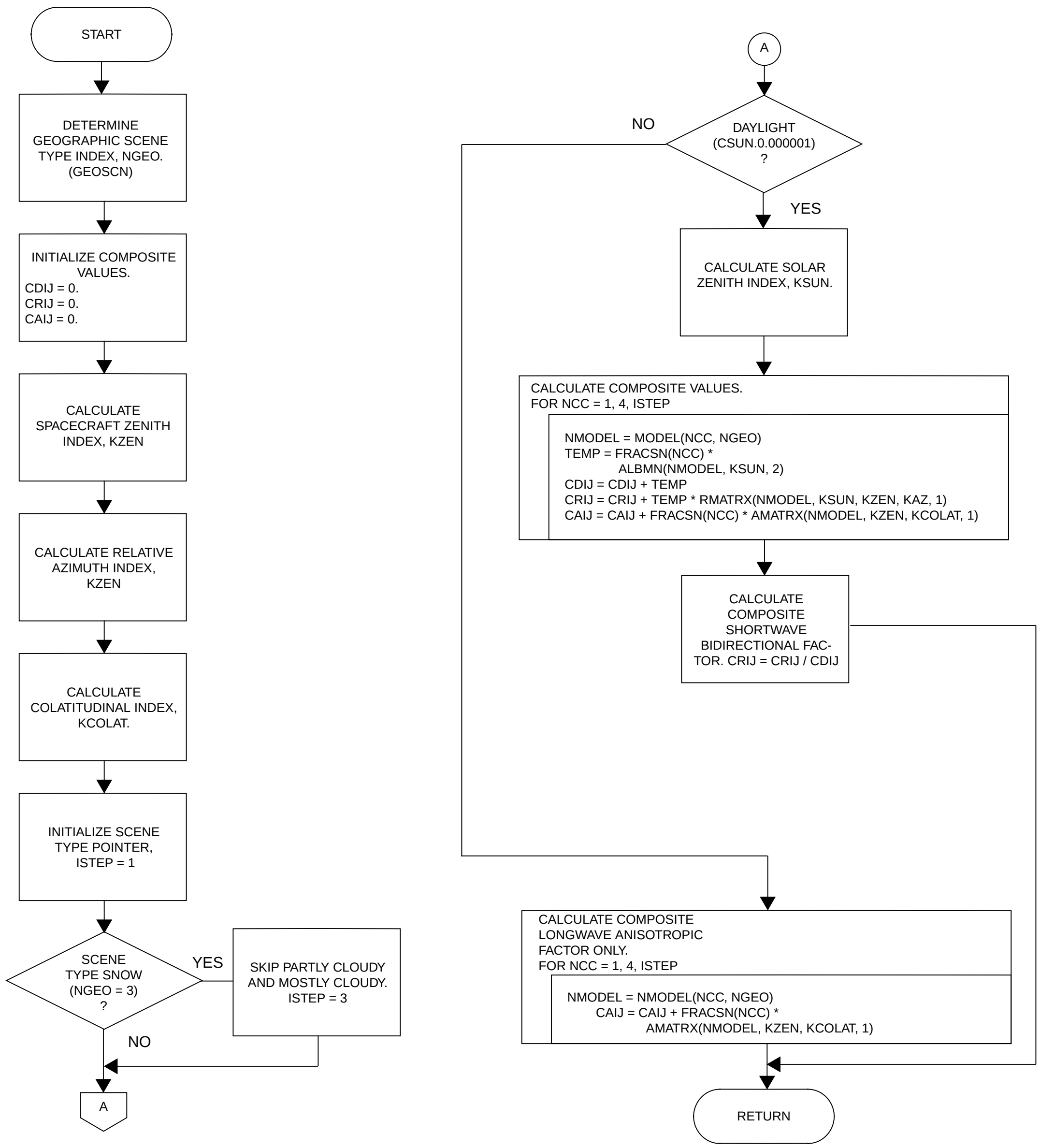


Figure 5.3-8. Flowchart of COMPOS (Module 5.3.1.2.2)

5.3.1.3 Driver for Numerical Filter Inversion (INVNF). Subroutine INVNF drives the calculation of the radiant exitances at the TOA by the numerical filter algorithm for longwave and shortwave measurements, MFOV and WFOV. For each 32-sec time interval, INVNF fills the **ESTNS** array with the four calculated TOA estimates or with a predetermined default value, XERROR (see **ESTNS** in COMMON Block /NSMEAS/, XERROR in COMMON Block /USPARM/). Subroutine NUMFIL (#5.3.1.3.1) is invoked to calculate the longwave radiant exitances. For shortwave radiant exitances, NUMFIL is invoked to calculate the term $A1^{INS}$; then INVNF calculates the shortwave TOA estimate by

$$\hat{M}_o^{INS,NF} = A1^{INS} * CSUNOO(0) * CDOO(0)$$

where the **CSUNOO** and **CDOO** arrays and the INS index are found in COMMON Block /NSMEAS/.

Longwave and shortwave inverted estimates are calculated only if sufficient data are available. Additionally, shortwave inverted estimates are calculated only if there is sufficient daylight in the FOV.

Figure 5.3-9 shows a Chapin Chart for this subroutine.

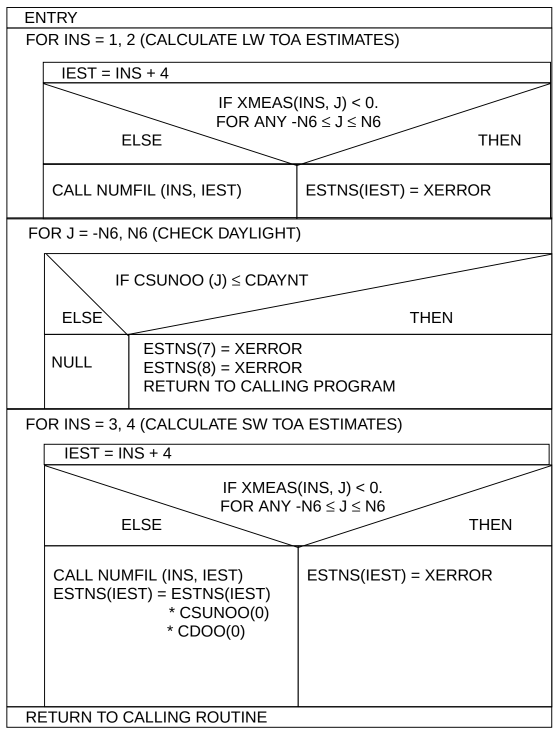


Figure 5.3-9. Chapin Chart for INVNF (Module 5.3.1.3)

5.3.1.3.1 Nonscanner Inversion by the Numerical Filter Algorithm (NUMFIL).

Subroutine NUMFIL calculates a square matrix, **B1313**, of influence coefficients from the **BMATRX** array, determines inversion weights, and calculates an estimate of longwave radiant exitance at the top of atmosphere or of the quantity, $A1^{INS}$, as described in the previous section. The **B**-matrices for each data type, INS, are stored in the **BMATRX** array (see COMMON Block /NSMEAS/). Each **B**-matrix is of the form

$$\mathbf{B}^{INS} = \begin{array}{c} \\ -N6 \\ \\ 0 \\ \\ N6 \end{array} \begin{array}{c} \begin{array}{ccc} -NSFOV & 0 & NSFOV \end{array} \\ \left[\begin{array}{ccc} \gamma_{-13}^{-6} & \cdots\cdots & \gamma_{13}^{-6} \\ . & . & . \\ . & \gamma_0^0 & . \\ . & . & . \\ \gamma_{-13}^{6} & \cdots\cdots & \gamma_{13}^{6} \end{array}\right] \end{array}$$

and contains influence coefficients γ_j^k for data type INS. Each matrix $\mathbf{B}^{INS}$ must be reduced to a square (2 * N6 + 1 x 2 * N6 + 1) matrix $\mathbf{B}13^{INS}$ where

$$\mathbf{B}13^{INS} = \begin{array}{c} \\ -N6 \\ 0 \\ N6 \end{array} \begin{array}{c} \begin{array}{ccc} -N6 & -5 \ldots\ 0\ \ldots 5 & N6 \end{array} \\ \left[\begin{array}{ccc} \sum\limits_{j=-13}^{0} \gamma_j^{-6} & \left|\gamma_1^{-6} \cdots\cdots \gamma_{11}^{-6}\right| & \sum\limits_{j=12}^{13} \gamma_j^{-6} \\ \sum\limits_{j=-13}^{-6} \gamma_j^{0} & \left|\gamma_{-5}^{0} \cdots\cdots \gamma_{5}^{0}\right| & \sum\limits_{j=6}^{13} \gamma_j^{0} \\ \sum\limits_{j=-13}^{-12} \gamma_j^{6} & \left|\gamma_{-11}^{6} \cdots\cdots \gamma_{-1}^{6}\right| & \sum\limits_{j=0}^{13} \gamma_j^{6} \end{array}\right] \end{array}$$

Elements of $\mathbf{B}13^{INS}$ can be calculated by

$$B13^{INS}(K,-6) = \sum_{J=-13}^{-(K+6)} B^{INS}(K,J) ,$$

$$B13^{INS}(K,J) = B^{INS}(K,J-K)$$

for J = -5 through 5,

and

$$B13^{INS}(K,6) = \sum_{J=6-K}^{13} B^{INS}(K,J) .$$

The elements of the center (zeroth) row of $(B13^{INS})^{-1}$ are taken as inversion weights, ω_j^{INS} (see subroutine SVD, #5.3.1.3.1.1).

Estimates of the longwave (INS = 1 or 2) radiant exitances at the TOA are calculated by the numerical filter technique according to

$$\hat{M}_0^{INS,NF} = \sum_{j=-N6}^{N6} \omega_j^{INS} \ m_j^{INS} ,$$

where the m_j^{INS} are the 2 * N6 + 1 consecutive average measurements on either side of, and including, measurement m_0^{INS}.

For the shortwave (INS = 3 or 4) case, the quantity

$$A1^{INS} = E_0 \, l(t) \hat{a}_0(1) = \sum_{j=-N6}^{N6} \omega_j^{INS} m_j^{INS}$$

is calculated where $\hat{a}_0(1)$ is the estimated overhead sun albedo, and the m_j^{INS} are the average measurements on either side of, and including, measurement m_0^{INS} (see comment regarding the $E_0 \, l(t)$ term near the end of Section 5.3.1.2). Estimates of the shortwave radiant exitance at the TOA are calculated in subroutine INVNF (#5.3.1.3) from the quantity $A1^{INS}$.

A Chapin Chart of subroutine NUMFIL is shown in Figure 5.3-10.

```
ENTRY
FOR K = -N6, N6 (CALCULATE SQUARE MATRIX)
    B1313(K, -N6) = 0
    FOR J = -NSFOV, -(K + N6)
        B1313(K, -N6) = B1313(K, -N6) + BMATRX(INS, K, J)
    FOR J = -N5, N5
        B1313(K, J) = BMATRX(INS, K, J-K)
    B1313(K, N6) = 0
    FOR J = N6 - K, NSFOV
        B1313(K, N6) = B1313(K, N6) + BMATRX(INS, K, J)
CALL SVD(B1313, W)  (INVERT B1313)
EST = 0.
FOR J = -N6, N6 (CALCULATE TOA ESTIMATE)
        EST = EST+ W(J6) * XMEAS(INS, J6)
ESTNS(IEST) = EST
RETURN TO CALLING ROUTINE
```

Figure 5.3-10. Chapin Chart for NUMFIL (Module 5.3.1.3.1)

5.3.1.3.1.1 Singular Value Decomposition Algorithm (SVD). Subroutine SVD calculates the inverse of the **B**13^{INS} matrix (see subroutine NUMFIL, Section 5.3.1.3.1) by the method of a singular value decomposition and computes smoothed inversion weights eliminating the high frequency components. See Reference 4 for a description of the singular value decomposition algorithm. Figure 5.3-11 contains a flowchart of subroutine SVD.

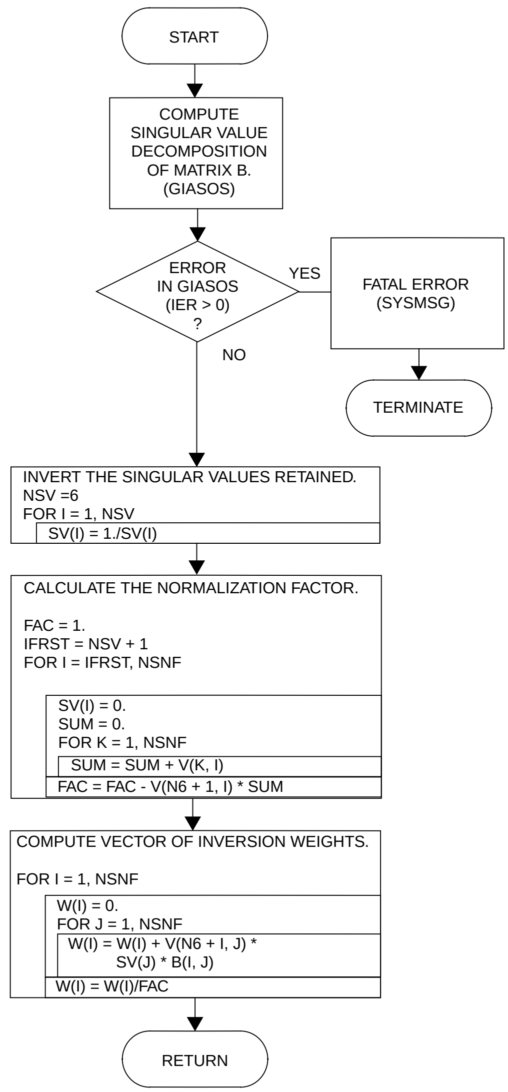


Figure 5.3-11. Flowchart of SVD (Module 5.3.1.3.1.1)

5.3.2 NONSCANNER SPECIAL PROCESSING MODE (NSSPEC)

Subroutine NSSPEC performs nonscanner data inversion using the shape factor method. Two separate shape factor techniques are employed. The first shape factor technique computes a TOA estimate using precomputed influence coefficients (see SFAC1, #G.5.9.1). The second shape factor method determines a TOA estimate based on a scene independent technique (see SFAC2, #G.5.9.2).

The scene dependent shape factor method is invoked under the following circumstances. If, during scanner processing, the “switching” logic detects a data dropout or an end-of-file on the input-PAT, the regular nonscanner processing mode will be unable to invert the last six measurement sets contained in the **XPATNS** array (see discussion in Section 5.3.1). In this event, subroutine NSSPEC is utilized to invert these measurements by the shape factor algorithm, using influence coefficients previously computed from subroutine NSREG (#5.3.1).

The scene independent shape factor method is invoked under the following circumstance. If the **XPATNS** array contains less than 13 nonscanner measurements, there are insufficient data to determine the transformation matrix, **ATRAN** (see Section 5.3.1.1). Therefore, the influence coefficients corresponding to the measurements in **XPATNS** cannot be calculated, and subroutine NSSPEC is invoked to invert the available nonscanner measurements by the scene independent shape factor technique that does not require influence coefficients.

Subroutine NSINV communicates choice of shape factor method to subroutine NSSPEC through the NSSPEC argument list utilizing the EXTERNAL statement capability (see subroutine NSINV flow diagram in Section 5.3).

After these estimates of the radiant exitance at the TOA have been found, nonscanner data required by the Daily Data Base Subsystem are calculated and output to a local file (see subroutine NSTSA, #G.5.10). This local file is required by the Inversion Subsystem Post-Processor if nonscanner TOA data and Inversion Subsystem supplied nonscanner data flags are to be provided on the PAT60 (see related NOTE in Section 5.2.1). See Figure 5.3-12 for a flowchart of NSSPEC.

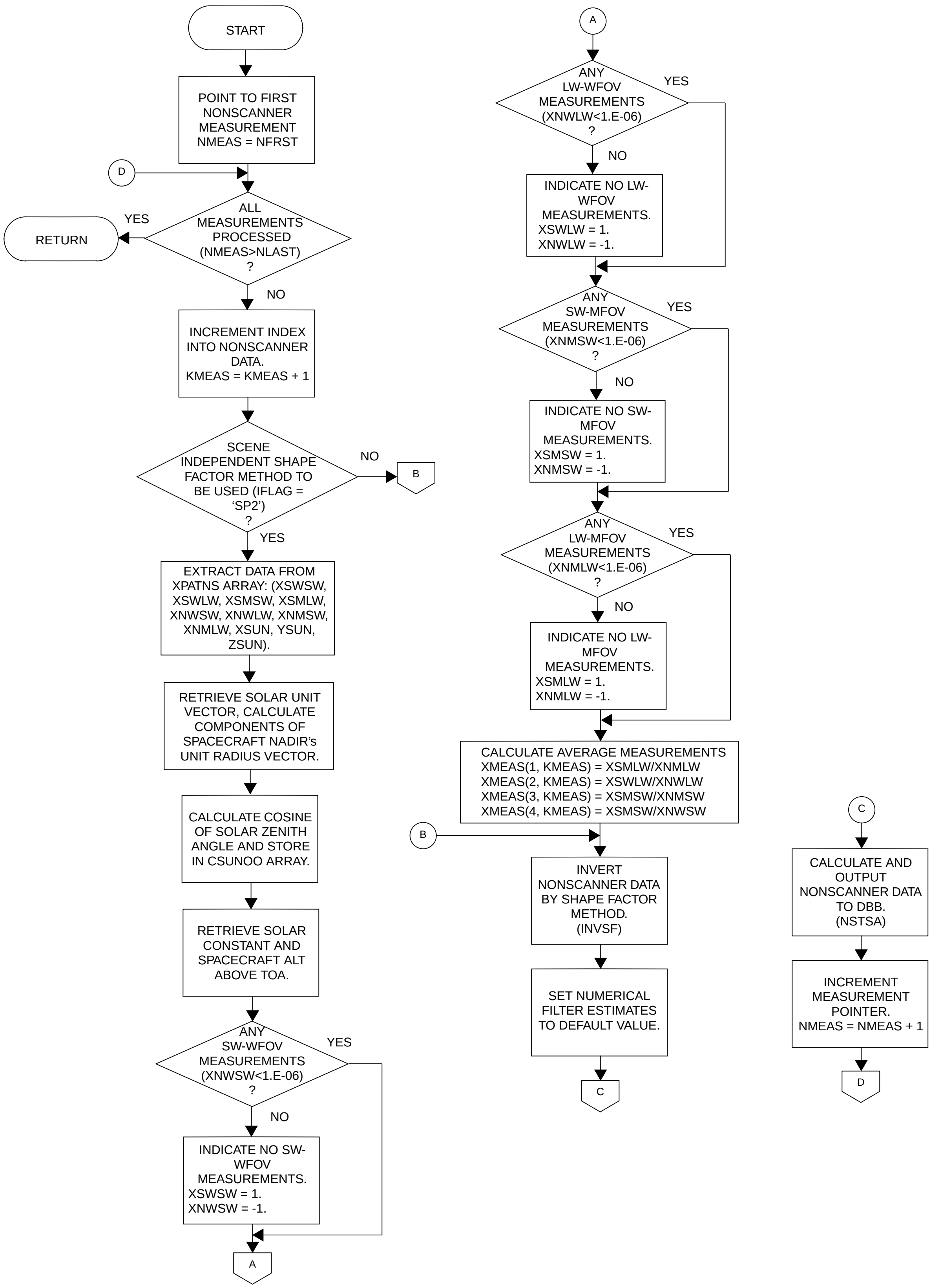


Figure 5.3-12. Flowchart of NSSPEC (Module 5.3.2)

5.4 FINALIZE MAIN-PROCESSOR PROCESSING (INVFIN)

After an end-of-file is encountered on the input-PAT and nonscanner processing is completed, subroutine INVFIN is invoked to finalize processing for the Inversion Subsystem Main-Processor. Subroutine ACTCLS (#5.4.1) computes regional scanner data for the remaining active scanner and histogram regions and outputs the information to the Daily Data Base Subsystem. The processing summary report, QC-7, is prepared by INVPS (#5.4.2). Logical header records for any of the Main-Processor's output products (scanner to DDB, nonscanner to DDB, histogram, daily ETVD, and PAT*) that were requested are written to a permanent file (ERBE TAPE80) by PUTHED (#G.E.8.3.7).

Figure 5.4-1 is a flowchart of INVFIN.

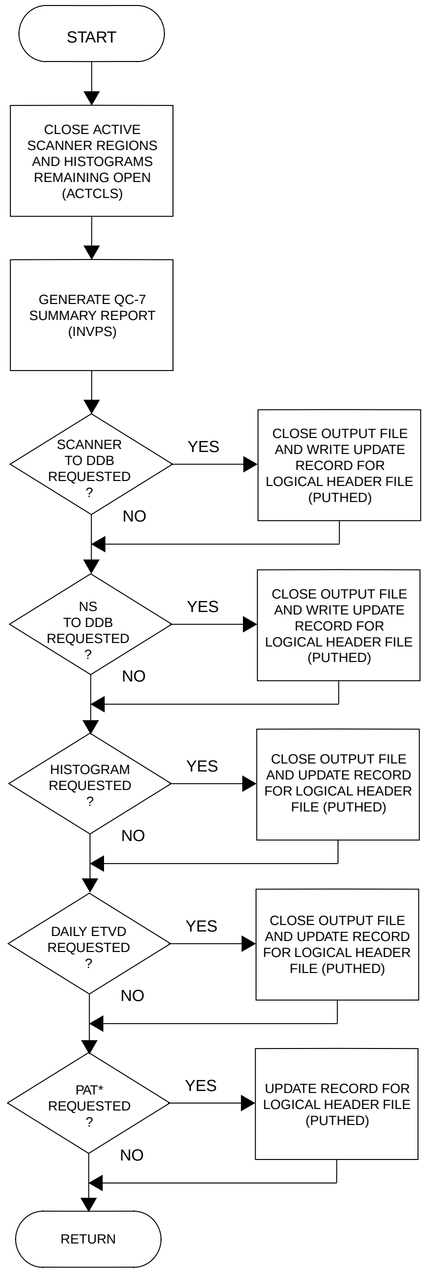


Figure 5.4-1. Flowchart of INVFIN (Module 5.4)

5.4.1 CLOSE REMAINING ACTIVE REGIONS (ACTCLS)

After an end-of-file is encountered on the input-PAT, there still may be data in the **XACT25** and **IACT25** arrays that must be reduced and output to the Daily Data Base Subsystem. For each of the NACT remaining active scanner regions, this required output is calculated and written to local file, ISCOUT, by subroutine SCTSA (#G.5.8). In addition, accumulated data for the NHIST remaining histogram regions are output to local file, IHOUT, by subroutine HISTO (#G.5.4).

XACT25, **IACT25**, and NACT are in COMMON Block /ACTREG/; ISCOUT and IHOUT are in COMMON Block /UNIT/; and NHIST is in COMMON Block /HIST/.

Processing of ACTCLS is shown in Figure 5.4-2.

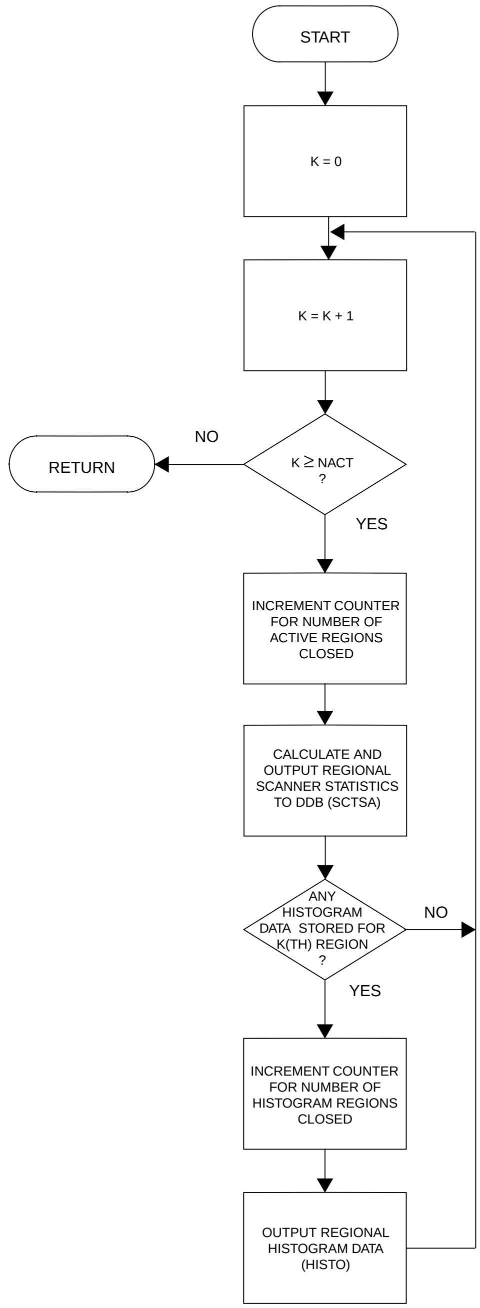


Figure 5.4-2. Flowchart of ACTCLS (Module 5.4.1)

5.4.2 INVERSION SUBSYSTEM MAIN-PROCESSOR PROCESSING SUMMARY (INVPS)

After processing the input-PAT and before general ERBE finalization routines are called, subroutine INVPS generates the seven page processing summary report, QC-7, for the Inversion Subsystem Main-Processor. Each page of the report contains the normal ERBE header generated by WRHDM (#G.E.8.6.2) along with data accumulated throughout SIMAIN processing. Figure B-2(a-g) is a sample listing of a QC-7 report. The COMMON Block /REPORT/ contains many of the storage arrays needed by INVPS. Other COMMON Blocks used are /HDBUF/, /INTERN/, and /SWOFF/.

The first page lists miscellaneous statistics for the data processed. The first column lists information about the number of input-PAT records processed, processing time, final altitude of the spacecraft, whether the spacecraft's orbit is circular or elliptical, and output products generated. The processing time in minutes is given for both CP time and wall time. The spacecraft's orbit is considered to be circular if the difference between apogee and perigee is less than equal to 30,000 m (see subroutine PARINT, #5.1.2).

At the top of the second column is a list of the five longest data dropout periods encountered during processing. The calendar time in an hour, minute, and second (with fraction) format and the spacecraft position (colatitude and longitude) for the start and stop of each dropout period are provided, along with the length of the period in minutes. The data used for this display are accumulated and stored in the **BLKOUT** array by subroutine RDPAT (#5.2.1) and are converted to the final displayed format in subroutine DRPDAT (#5.4.2.1).

The remainder of the second column consists of a count of the total number of data dropouts, the number of switches made between scanner and nonscanner data processing, and various other statistics accumulated during SIMAIN processing. These data are stored in the **ISTAT** array. Where applicable, the limits for acceptable values are shown.

The top portion of column three gives a statistical summary for 2.5-deg scanner regions (see subroutine SCACUM, #5.2.5), 5-deg and 10-deg nadir regions (see subroutine NSSCN, #G.5.2), and 2.5-deg histogram regions (see subroutine HISTO, #G.5.4). These values are stored in the **ISTAT** array. “Closed Normal” is an indication of the number of regions closed at the completion of routine scanner and nonscanner data processing. The “Closed Final” heading shows the number of regions finally processed in subroutine ACTCLS (#5.4.1) following routine data processing. The maximum number of regions opened at any one time during routine data processing is shown under “MAX.” The number of regions remaining open is the difference between the number opened and the total number (normal and final) closed. Column three also lists values for various input constants used during SIMAIN processing along with the orbital parameters as determined in subroutine PARINT (#5.1.2).

Page two shows in tabular form the distribution of longwave, total, and daytime shortwave measurement sampling, geo-scene sampling, and cloud cover sampling as a function of 10-deg colatitudinal zones. A discussion of geo-scene types and cloud cover classifications can be found in Sections 5.2.2.1 and A.4. The number of good shortwave (daytime), longwave, and total scanner measurements are listed in the first three columns according to 10-deg colatitudinal zones. The fourth column is a ratio of daytime to nighttime measurements available from the total channel. The global values listed under the first three columns represent the number of good acceptable measurements. The bad values indicate, for the particular scanner channel, the number of bad radiometric flags encountered. It should be noted that measurements with bad FOV flags are not included in either count.

The next five columns show the actual underlying geo-scene sampling versus the modeled sampling that would occur if each 2.5-deg region were observed once. The modeled geographic scene type for each 2.5-deg region is stored in the **DYNID** array as character data (see Table A-6a). INVPS determines and maintains the geo-scene modeled sampling for each 10-deg zone in the **IGMODL** array. The contributing percentages of each scene type in a zone are calculated, converted to integer (subroutine GEOSCN, #G.5.6), and summed, with the sum ensured to total 100.

NOTE: Due to roundoff errors, the percentages may not at first total 100. To solve this problem, the difference between 100 and the sum is added to the largest contributing percentage where it will have the smallest impact. Note that this will not apply if the sum equals 0.

Actual zonally sampled counts for each geo-scene type are accumulated in **IGSAMP** during scanner data processing. Zonal percentages for each type's contribution are calculated and summed, with this sum ensured to equal 100 (or 0). The contributing percentages of each cloud cover category to the zonal total are calculated from the array IMSAMP(I, IMOD), where I is the 10-deg colatitudinal zone index and IMOD is the scene type. These percentages are also ensured to total 100 (or 0).

A weighted average cloud cover, AMT, for the zone is determined from

$$\text{AMT} = .025 * \%\text{Clear} + .275 * \%\text{Partly Cloudy} \\ +.725 * \%\text{Mostly Cloudy} + .975 * \%\text{Overcast}.$$

The weighting factors .025, .275, .725, and .975 are the mean cloud cover fractions for the four categories.

After calculating the percentage contribution of each cloud cover category, the percentage contributions to the zone by each of the twelve scene types is calculated. The global statistics are calculated from the accumulated data over all 10-deg colatitudinal zones.

Figure 5.4-3 is a flowchart of the processing that produces page 2 of QC-7.

The first two sections of page three (upper portion) show the results of the ERBE scene identification algorithm (subroutine SCNID, #5.2.2.1) as a function of the seven spacecraft viewing zenith bins (also see Table 5.2-11), for daytime and nighttime, and of the 10 solar zenith bins (also see Table 5.2-11). During scanner data processing, the number of cloud cover classifications determined by the scene identification algorithm is maintained. The NUM columns show the percentage distribution of this number according to spacecraft viewing zenith and solar zenith bins. The AMT column is a weighted average cloud cover and is calculated as shown above. Daytime sample counts (spacecraft viewing zenith) are stored in the IVZDAY(K, NCC) array, nighttime counts (spacecraft viewing zenith) are stored in IVZNIT(K,NCC), and solar zenith counts are stored in ISZEN(K, NCC), where K is the appropriate bin index, and NCC is the cloud cover category index (see Table 5.2-10). The values shown on the lines labeled TOTAL are calculated

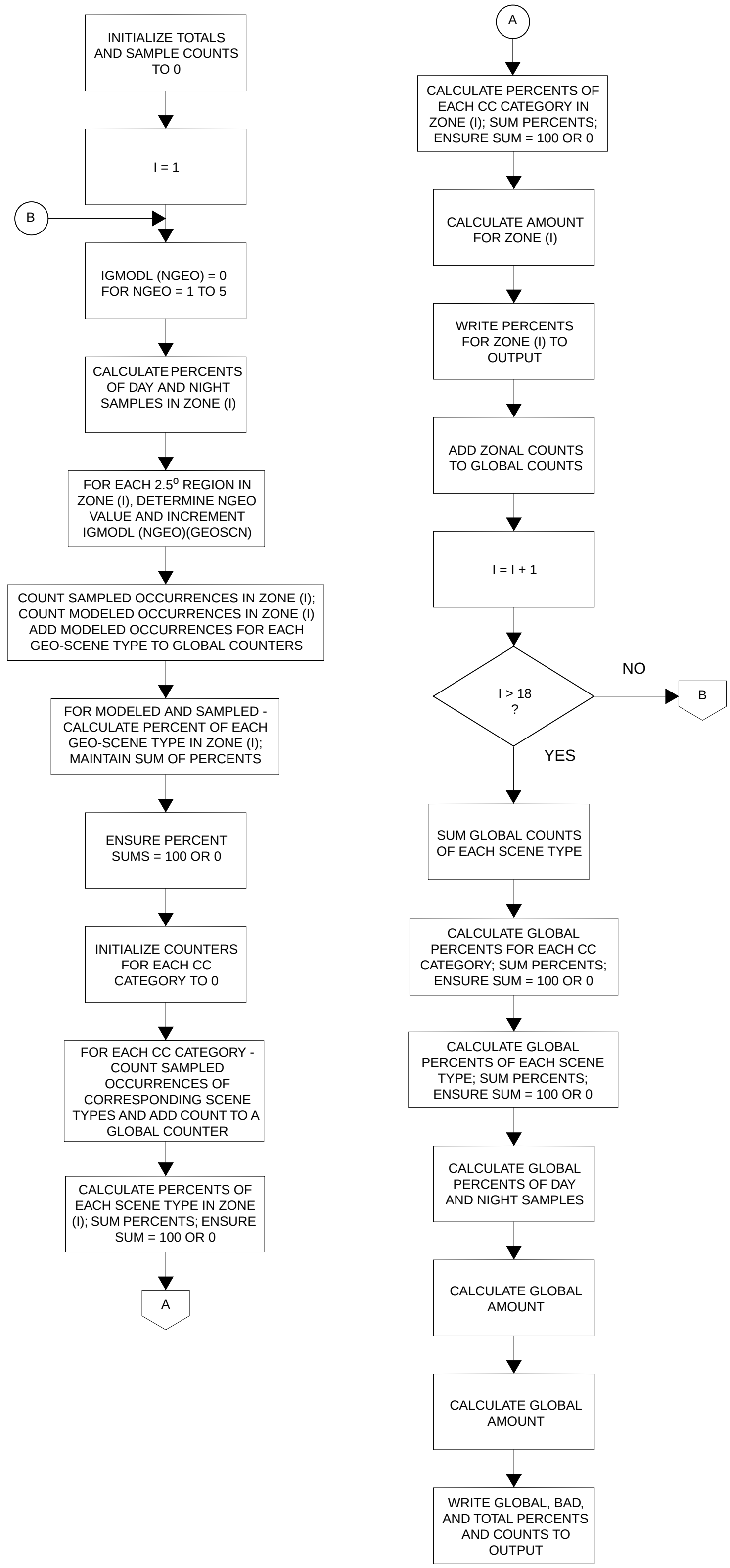


Figure 5.4-3. Flowchart of QC-7, Page 2 Processing

based on the counts accumulated from all of the bins. Figure 5.4-4 is a flowchart of the processing involved to produce this section of page 3.

The scene identification algorithm (subroutine SCNID, #5.2.2.1) calculates a 1-dimensional standard deviation “miss,” SIG1D, a shortwave standard deviation “miss,” SIGSW, and a longwave standard deviation “miss,” SIGLW, each for the most probable scene. If SIG1D is greater than SIGMAX (nominally 8-sigma, see NAMELIST $NLIMIT), the scene type is classified as unknown.

The rightmost section of the upper portion of the third page lists the number of scene classifications for which SIG1D is from 1-sigma to 29-sigma. The number of scenes with a SIG1D value of 30-sigma or greater is shown by the label “30+.” These data are stored in the **ISIG1D** array.

The lower portion of page three is a histogram of the distribution of the most probable scenes’ longwave and shortwave standard deviations. This information comes from SIGLW and SIGSW as stored in the two-dimensional array **ISIGMA**.

Page four of the QC-7 report contains 10-deg weighted zonal averages for the different instruments and inversion techniques. The instruments are the scanner, NFOV, and the nonscanner, both WFOV and MFOV. The inversion techniques implemented for the nonscanner are shape factor and numerical filter (for a discussion of these techniques see Section 5.3.1). Weighted shortwave and longwave TOA estimates and albedo averages, each followed by a measurement count, are given for each technique. The columns labeled MEAS are 10-deg zonal averages of shortwave and longwave nonscanner 32-sec average measurements at spacecraft altitude. The zonally weighted averages are calculated by subroutine NEST (#5.4.2.2). Separate calls to NEST are made for averaging estimates for the 2.5-deg scanner, the WFOV 10-deg shape factor method, WFOV 5-deg numerical filter method, MFOV 10-deg shape factor method, and the MFOV 5-deg numerical filter method. Parameters passed with each call to NEST include NDIM, the number of sub-zones in 180 degrees, THSUN, the solar colatitude as calculated from the last input-PAT record, and storage arrays containing shortwave, longwave, and albedo estimate sums and the number of estimates.

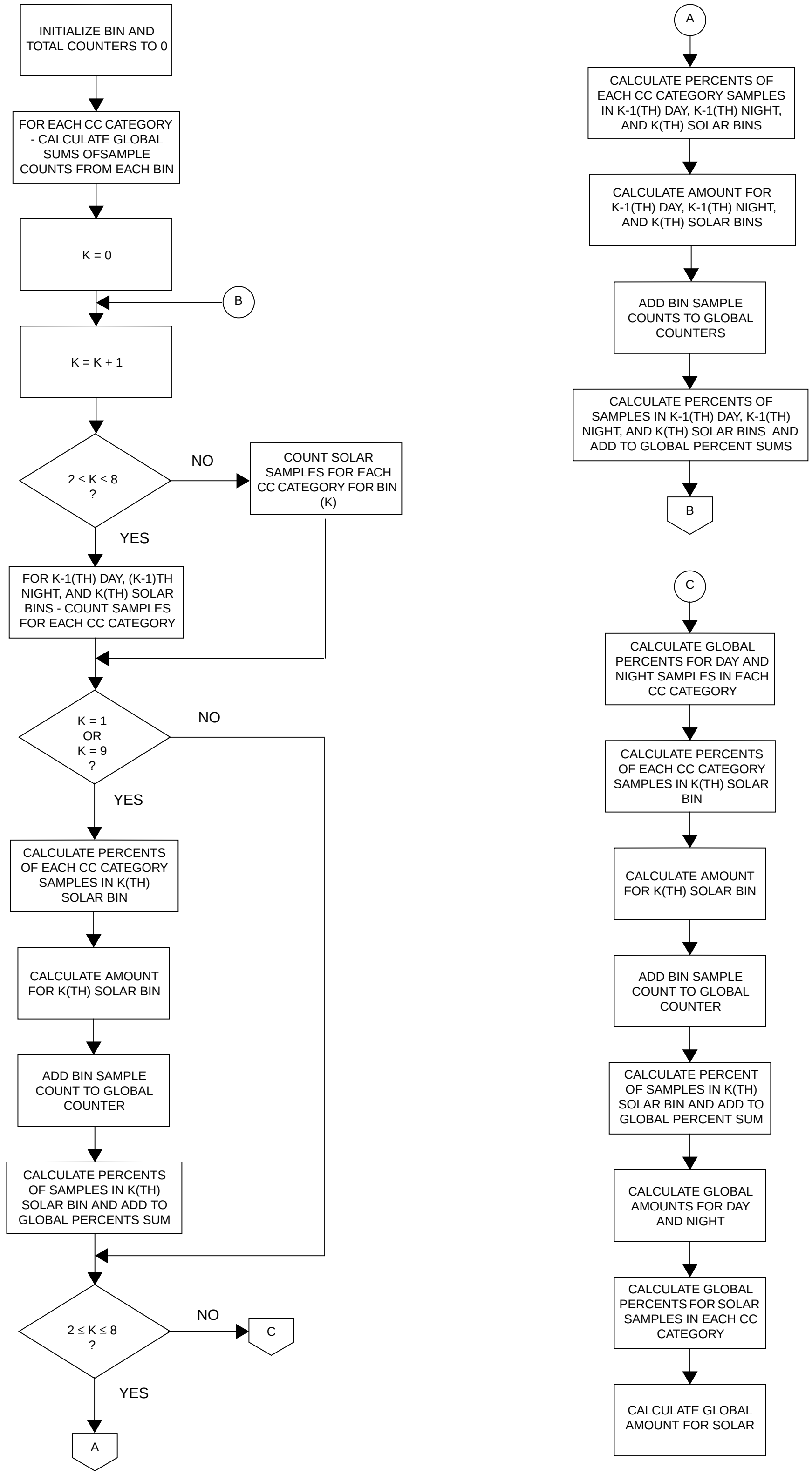


Figure 5.4-4. Flowchart of QC-7, Page 3 Processing

Table 5.4-1 lists the values for NDIM and the storage arrays passed to NEST for each technique. The first storage array listed for each technique contains sub-zonal sums of shortwave estimates while the second array listed contains the number of shortwave sub-zonal estimates. The third and fourth arrays contain the sub-zonal sums for longwave estimates and the number of estimates for each sub-zone. The last array listed will contain the sum of albedoes for each sub-zone.

Table 5.4-1. Storage Arrays Passed to Subroutine NEST

Technique	NDIM	Storage Arrays
Scanner, 2.5-deg Estimates	72	**XSCANS, ISCANS, XSCANL, ISCANL, XSCANA**
WFOV, 10-deg Shape Factor Method	18	**XWFSFS, IWFSFS, XWFSFL, IWFSFL, XWFSFA**
WFOV, 5-deg Numerical Filter Method	36	**XWFNFS, IWFNFS, XWFNFL, IWFNFL, XWFNFA**
MFOV, 10-deg Shape Factor Method	18	**XMFSFS, IMFSFS, XMFSFL, IMFSFL, XMFSFA**
MFOV, 5-deg Numerical Filter Method	36	**XMFNFS, IMFNFS, XMFNFL, IMFNFL, XMFNFA**

Along with the 10-deg zonal averages, NEST returns global averages and the associated number of samples for each technique, which are displayed on the last line of output on page four.

Page five of this processing summary report is a table of differences between the 10-deg zonal and global averages for the different techniques listed on page four. Differences are given for both the shortwave and the longwave and are calculated as follows.

Scanner - WFOV, Shape Factor
Scanner - WFOV, Numerical Filter
Scanner - MFOV, Shape Factor
Scanner - MFOV, Numerical Filter
WFOV, Numerical Filter - WFOV, Shape Factor
WFOV, Numerical Filter - MFOV, Numerical Filter
WFOV, Shape Factor - MFOV, Shape Factor
MFOV, Numerical filter - MFOV, Shape Factor.

Page six is a table of the shortwave offsets that are applied to correct the daytime SW filtered measurements for each orbit. These offsets are accumulated from nighttime SW measurements from the NFOV, MFOV, and WFOV instruments and are calculated in subroutine SWZERO (#5.2.1.1). Also determined in SWZERO are the time spans (in Julian time) between the time on the first data record, TORIG, and the time of the data when the offsets for each orbit were calculated. The offsets and time spans are stored in the **PSOFF** array.

Subroutine INVPS converts the time of the first data record from Julian to calendar time and displays it in the YY/MM/DD-HH/MM/SS format. The offsets used for each orbit are listed, along with the time, in minutes, between offset calculations. The first time difference listed is the difference between the first data record and the time of the data when the offsets for the first orbit were calculated. In the event of large data dropout periods, all fifteen sets of offsets will not be calculated, and the last time difference shown will be the time of the first data record minus the time of the data when the last offsets were calculated (all in minutes). After the offsets and time differences are listed, the number of rejects and large data dropout periods (nighttime to nighttime, daytime to daytime, and nighttime to daytime) are given.

The number of “rejects due to insufficient data” for each instrument are the number of occurrences where there was not a sufficient number of measurements (200 for NFOV, and 20 for both MFOV and WFOV) to calculate an offset, and the offset was therefore set equal to 0. The number of “rejects due to exceeding limit” are the number of occurrences where the calculated offset exceeded 5 $wm^{-2}sr^{-1}$ and was therefore set equal to 0.

A discussion of the three data dropout periods can be found in Section 5.2.1.1.

The last page of the QC-7 report lists the Earth Target Validation Regions according to their 2.5-deg region numbers along with the number of samples counted for each region. Also listed on this page are the contents of the header record (**IBUF** arrays) for each input and output product associated with the execution of SIMAIN (see Figure B-2).

5.4.2.1 Determining the Time Span of a Data Dropout Period (DRPDAT).

Subroutine DRPDAT determines the start and stop times of a data dropout period. The starting and stopping times of the five largest data dropout periods encountered during SIMAIN processing are stored in the **BLKOUT** array. The **BLKOUT** array is accumulated in subroutine RDPAT (#5.2.1) and is passed to DRPDAT from subroutine INVPS (#5.4.2) as a formal parameter.

DRPDAT processes one data dropout period per call. The input parameter IPER points to which period is to be processed. JULCAL (#G.E.8.5.2) is called to convert the Julian dates to calendar dates. The hours, minutes, and seconds returned from JULCAL are the values that will be returned to the calling routine. Also calculated is DELTIM, the length in minutes of the data dropout period. If DELTIM is less than 0.17 minutes (10 seconds), the period is not a data dropout period, and the hour values (starting and stopping) returned from JULCAL are redefined as 0.

Figure 5.4-5 is a flowchart of DRPDAT.

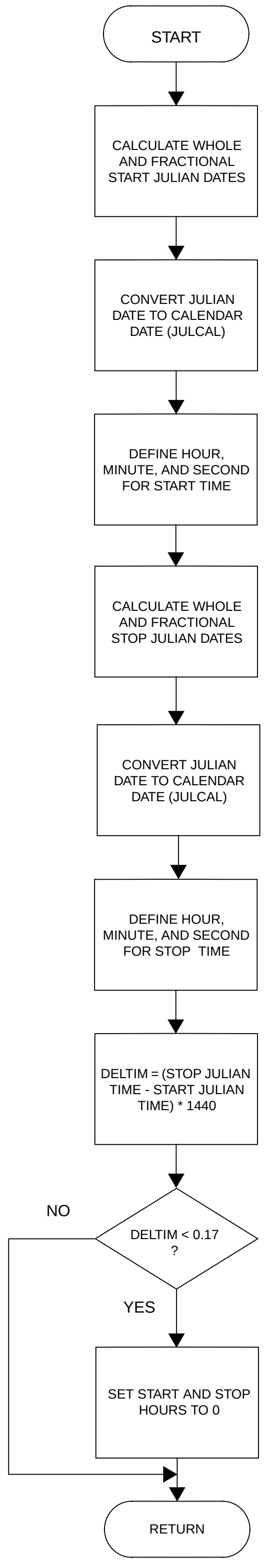


Figure 5.4-5. Flowchart of DRPDAT (Module 5.4.2.1)

5.4.2.2 Calculating 10-deg Zonal Albedo, SW, and LW Averages (NEST).

Subroutine NEST calculates 10-deg zonally weighted averages of albedo, shortwave, and longwave data. These weighted averages are based on 2.5-deg, 5-deg, or 10-deg sub-zonal means. The 10-deg values are then used to calculate global albedo, shortwave, and longwave values.

Input parameters to NEST include NDIM, THSUN, and storage arrays containing sub-zonal averages and sample counts for the albedo, shortwave, and longwave. NDIM is the dimension of the storage arrays passed to NEST and is equal to the number of sub-zones in 180 degrees, i.e. 72 for 2.5-deg sub-zones, 36 for 5-deg sub-zones, or 18 for 10-deg sub-zones. THSUN is the solar colatitude from the last input-PAT record as converted to radians. The sub-zonal averages and sample counts are based on TOA estimates accumulated during scanner and nonscanner processing.

Each sub-zonal albedo average is weighted by the area of the sub-zone that is in sunlight. The longitudinal boundary of the sun terminator, ETA, for the sub-zone must be calculated prior to the weighting factor. CETA, the cosine of the boundary angle, is calculated by the following equation in which CTHSUN and STHSUN are the cosine and sine of the solar colatitude, and CTH and STH are the cosine and sine of the colatitude of the sub-zone.

CETA = -CTHSUN/STHSUN * CTH/STH

If CETA is equal to -1, the sub-zone is in total sunlight, and ETA is set to 180 degrees, and SETA (sin (ETA)) is set to 0. If CETA is equal to 1.0, the sub-zone is in total darkness, and ETA is set to 0 degrees, and SETA is set to 0. Otherwise,

$$\mathrm{ETA} = \cos^{-1}(\mathrm{CETA})$$

and

$$\mathrm{SETA} = \sin\,(\mathrm{ETA}).$$

These values are used to calculate WT, the albedo sub-zonal weighting factor. In the next equation, DTH is the latitudinal dimension of the sub-zone in radians, TH is the colatitude of the sub-zone center, and SDTH is the sine of DTH.

```
WT = (DTH - SDTH + 2.* SDTH * STH **2) * SETA * STHSUN
    + (SDTH * STH * CTH) * 2.* ETA * CTHSUN.
```

STH is the latitudinal weighting factor for SW and LW averages.

Zonally weighted averages and sample counts are accumulated for the albedo, shortwave, and longwave. The following equations demonstrate the calculation of zonally and globally weighted averages.

$$\chi_k^{10^\circ} = \frac{\sum_{i=1}^{ISUB} \omega_i \bar{\chi}_i}{\sum_{i=1}^{ISUB} \omega_i}$$

and

$$\bar{\chi}_{global} = \frac{\sum_{k=1}^{18} \sum_{i=1}^{ISUB} \omega_i \bar{\chi}_i}{\sum_{k=1}^{18} \sum_{i=1}^{ISUB} \omega_i},$$

where

$\bar{\chi}_i$ is either the albedo, shortwave, or longwave sub-zonal average,

ω_i is WT for albedo or STH otherwise,

$\chi_k^{10^\circ}$ is the weighted average for the k^{th} 10-deg zone,

$\bar{\chi}_{global}$ is the weighted global average,

and

ISUB is the number of sub-zones in a 10-deg colatitudinal zone.

Figure 5.4-6 is a flowchart of NEST.

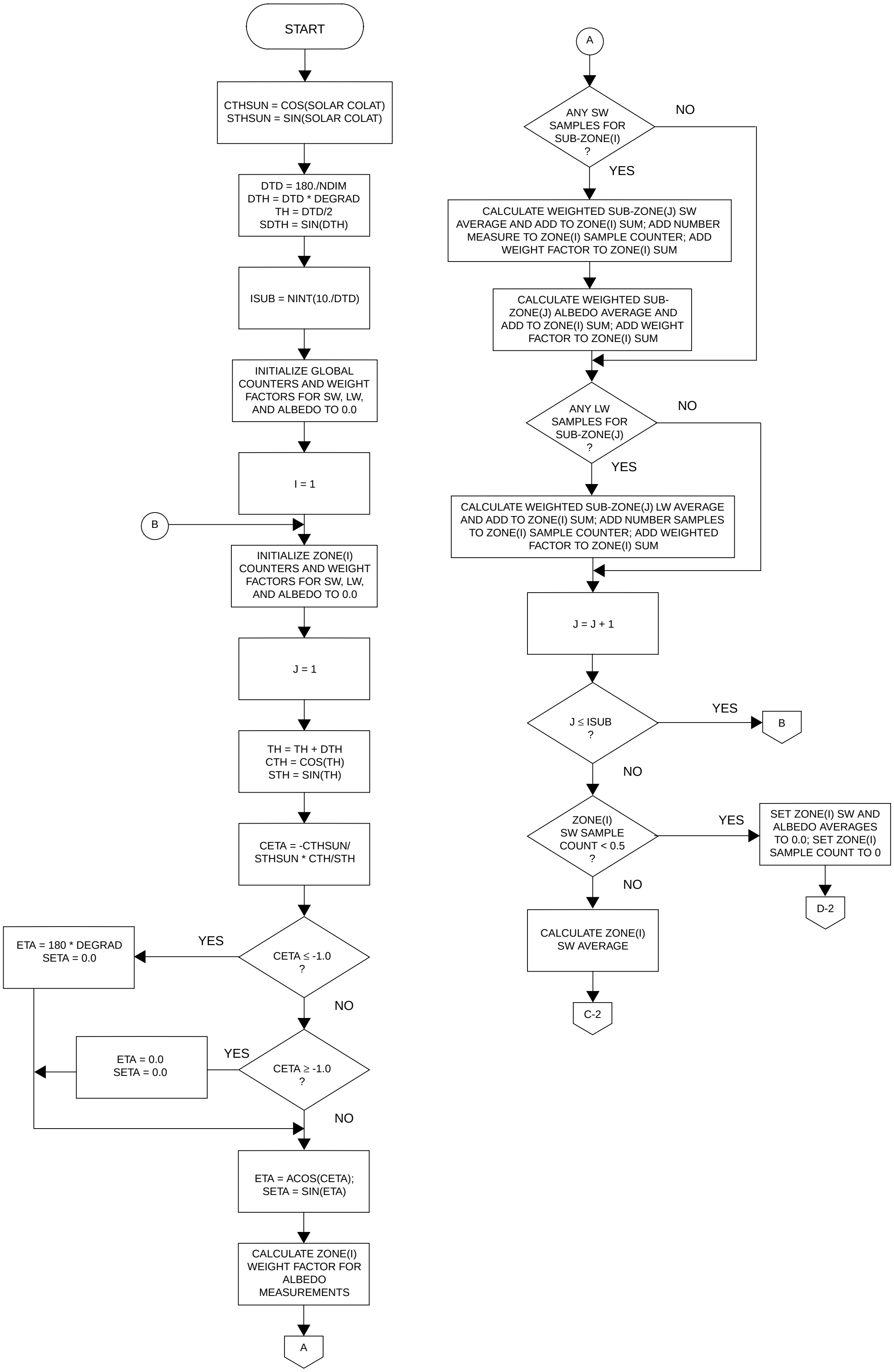


Figure 5.4-6. Flowchart of NEST (Module 5.4.2.2) (1 of 2)

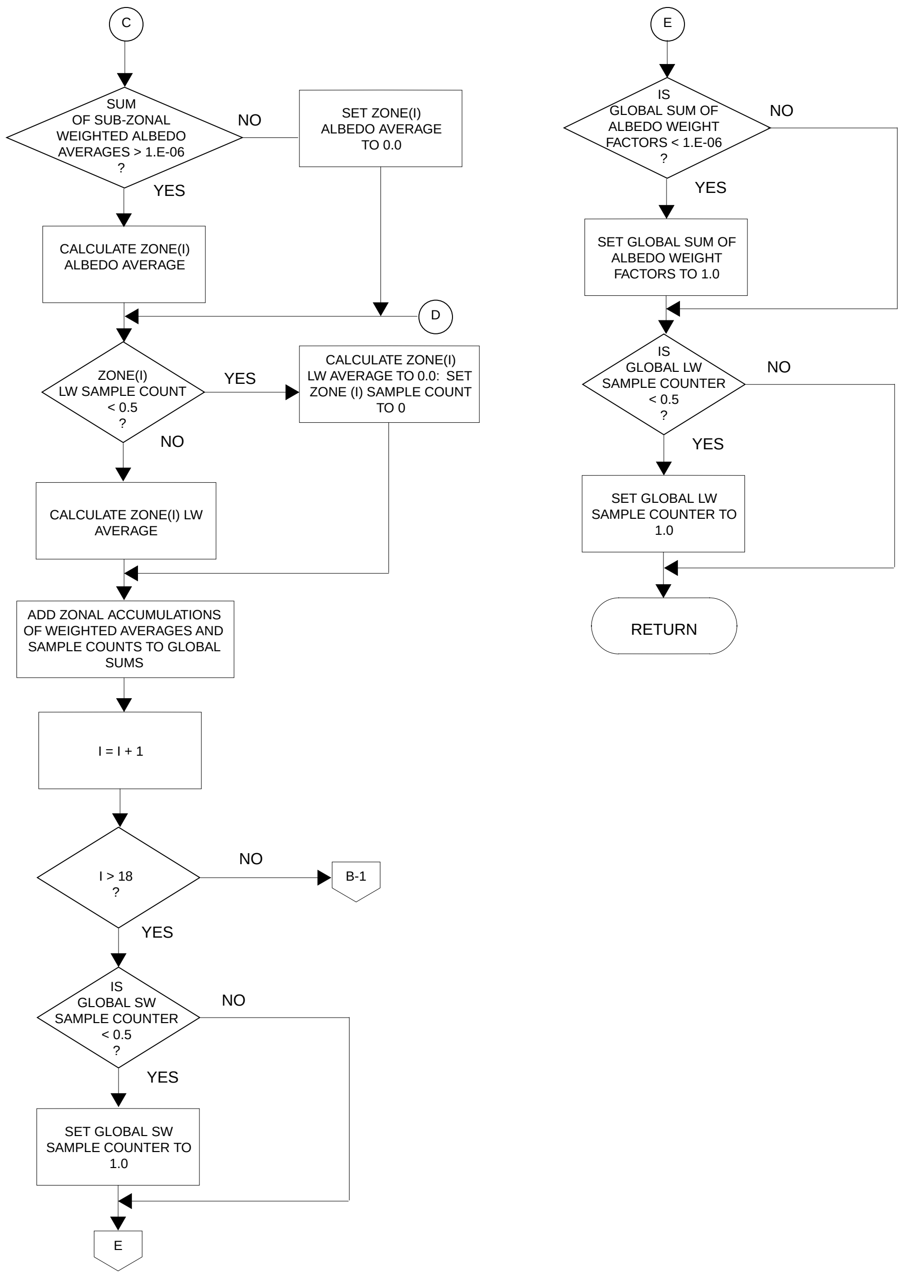


Figure 5.4-6. Flowchart of NEST (Module 5.4.2.2) (2 of 2)

5.5 INVERSION SUBSYSTEM POST-PROCESSOR (INVPP)

The Inversion Subsystem Post-Processor is responsible for the following tasks:

- To merge the Nonscanner output to Daily Data Base Subsystem (nonscanner to DDB, ID-7, with the Inversion Subsystem Main-Processor scanner and nonscanner output product (PAT*, ID-20), to produce the unpacked Processed Archival Tape (PAT60, ID-24). Section A.2 discusses the ID-20 and ID-24. Also, see NOTE in Section 5.2.1 regarding the ID-7.

- To select a subset of the PAT60 to produce the daily Medium-Wide FOV Data Tape (daily MWDT, ID-12) file. Section B.6 describes this product

- To use the Scene Validation Data Time Table (see **VDTIM** array, Section B.8) from the Main-Processor to select output records for the Scanner and Nonscanner Scene Validation Data Product (scene validation data, ID-4). The ID-4 is described in Section B.2.

The module INVPP drives the Inversion Subsystem Post-Processor. After the initialization of local variables and system utilities, NAMELIST input files are read. The NAMELISTs include $NINVPP, which contains the necessary processing and control parameters to execute the Post-Processor, $NPPOUT, which contains unit numbers and product requests supplied by the Inversion Subsystem Main-Processor, and $NAMGLB, the NAMELIST of ERBE System processing constants. If the scene validation data is requested, the Scene Validation Data Time Table as calculated by the Main-Processor is read from NAMELIST $NVTOUT. The NAMELISTs $NPPOUT and $NVTOUT are contained on the same input file which is shown in Table B-7. Parameters contained on $NINVPP are shown in Table A-8h. For a discussion of $NAMGLB see Reference 5. Errors encountered while reading the NAMELISTs are flagged as fatal, and SYSMSG (#G.E.8.4.1) terminates processing.

If the ID-24, ID-4, or ID-12 is requested, INITPP (#5.5.1) is called to check the availability of input products and calculate logical header records for the requested output products. INITPP also turns off requests for output products that cannot be generated due to the lack of a required input product. Should the nonscanner to DDB not be available, INITPP turns off the request for the daily MWDT, calls PATBUF (#G.5.15) to copy the PAT* to the remaining requested products, and sets the flag IRDFLG to one to indicate an end-of-file has been reached on the PAT*. When control is returned from INITPP, the product requests are again checked. If all requests were turned off by INITPP and IRDFLG is not equal to one, the result is a fatal error, and processing is terminated. In order to merge the PAT* input with nonscanner to DDB input and to generate requested output products, subroutine DATRUN (#5.5.2) is called. Next, INPPPS (#5.5.3) generates the written processing summary report, QC-7 (see Section B.11). Finally, any opened files are closed and PUTHED (#G.E.8.3.7) writes the logical header records for requested output products to ERBE TAPE80.

Figure 5.5-1 is a functional structure chart of the Inversion Subsystem Post-Processor. The data processing flow is illustrated in Figure 5.5-2. Figure 5.5-3 is a flowchart of the module INVPP.

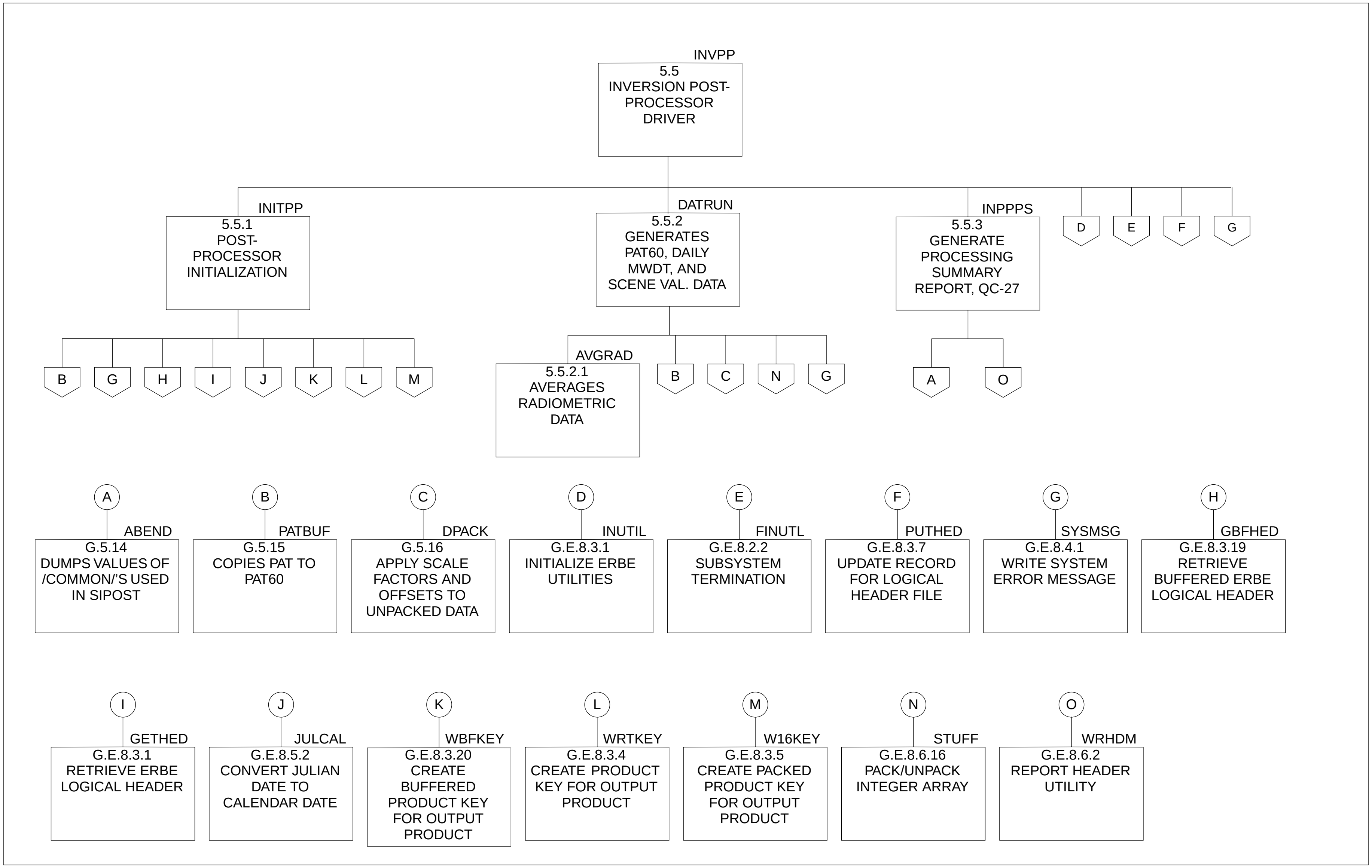


Figure 5.5-1. Inversion Post-Processor Structure Diagram

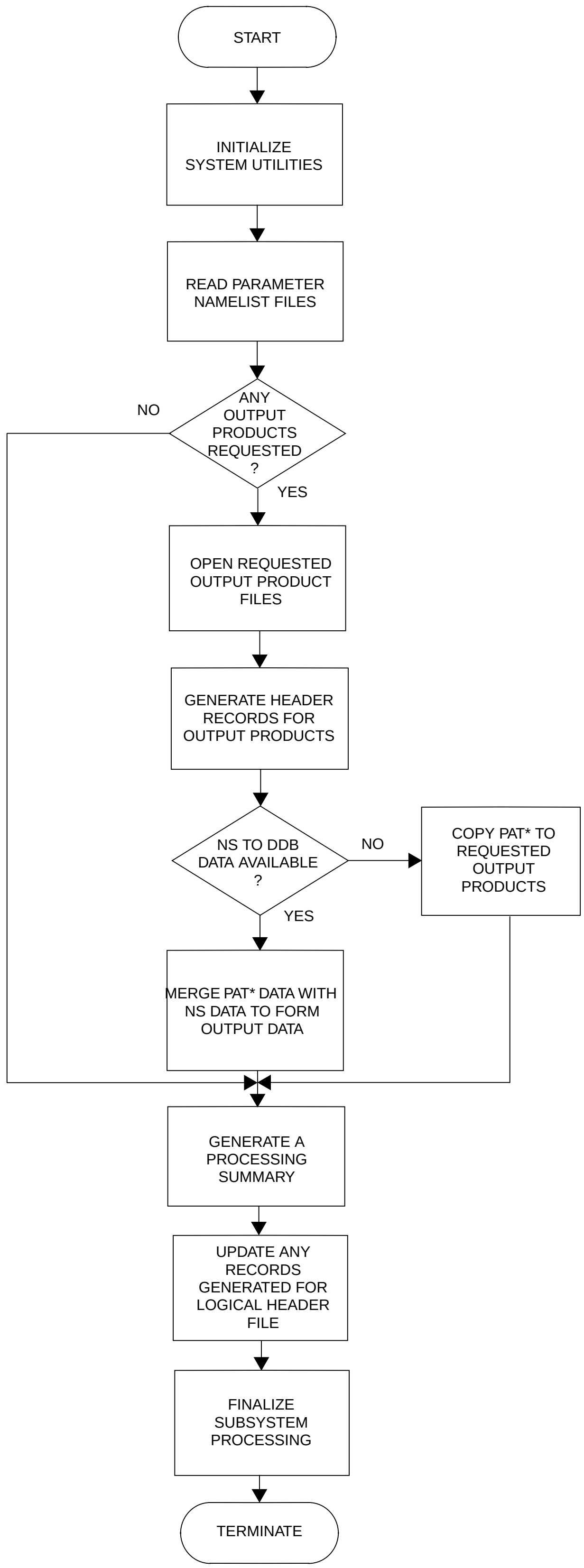


Figure 5.5-2. Inversion Post-Processor Data Processing Flow

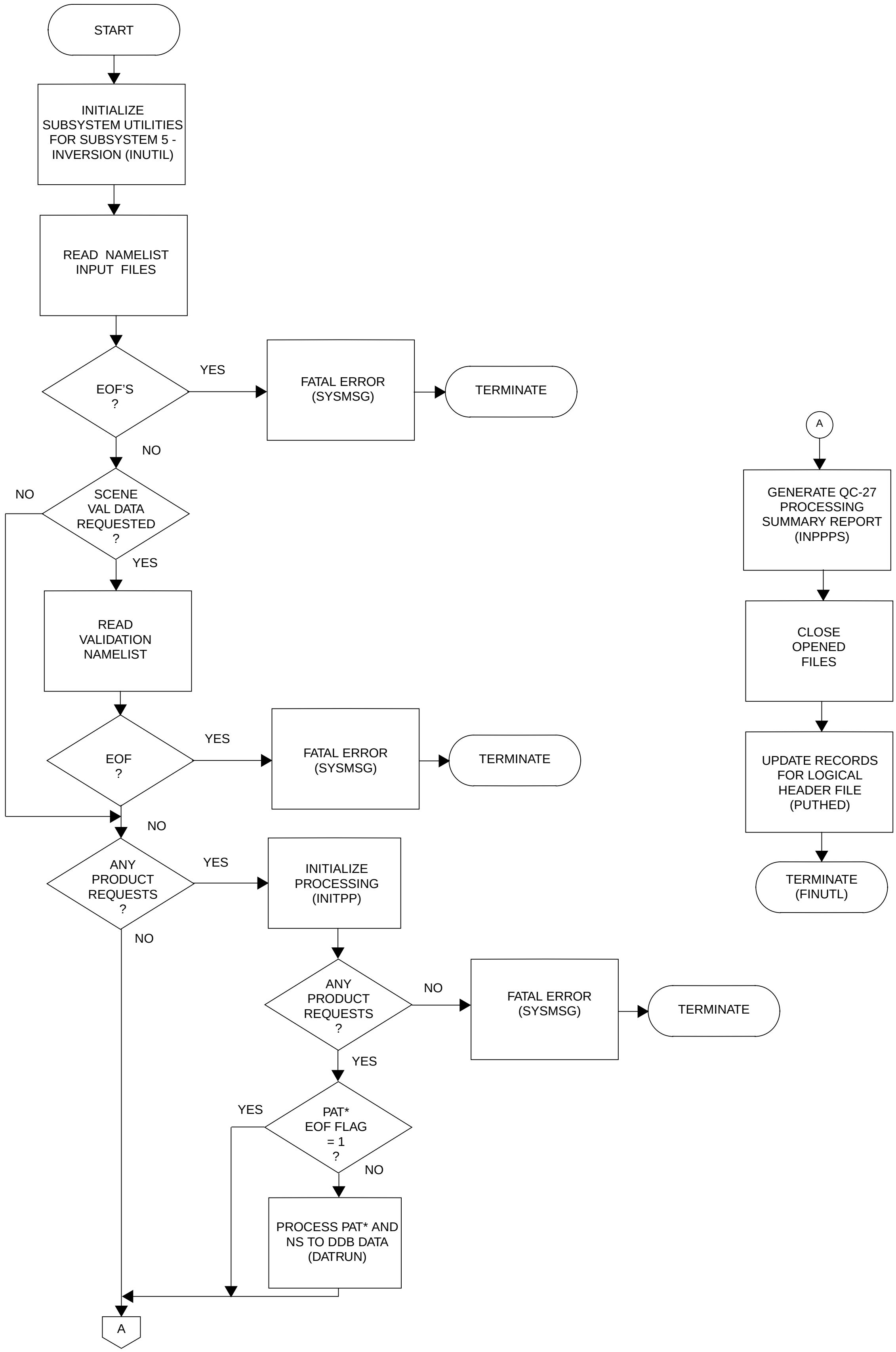


Figure 5.5-3. Flowchart of INVPP (Module 5.5)

5.5.1 INITIALIZATION OF THE INVERSION SUBSYSTEM POST-PROCESSOR (INITPP)

Subroutine INITPP checks the availability of necessary input files and initiates processing for requested output products. Should the PAT* not be available, requests for all output products (PAT60, scene validation data, and the daily MWDT) are turned off. Otherwise, the PAT* logical header record is retrieved, and the calendar date of the data calculated.

Output files are opened and logical header records and product keys calculated for the scene validation data and PAT60 products as requested. The Scene Validation Data Time Table provided by the Main-Processor is also written to the ID-4 output file.

If the nonscanner to DDB file is available and contains data, the daily MWDT may be processed. If the daily MWDT product is requested, MWDT scale factors and offsets are read from an input file with any read errors resulting in the MWDT product request being turned off and an informative error generated. The output file is then opened, and the logical header record elements and product keys are determined. If no nonscanner to DDB data are available, the daily MWDT request is turned off, the flag IRDFLG, originally set to zero, is set equal to one, and the PAT* is copied to the remaining requested output products by subroutine PATBUF (#G.5.15).

Figure 5.5-4 is a flowchart of INITPP.

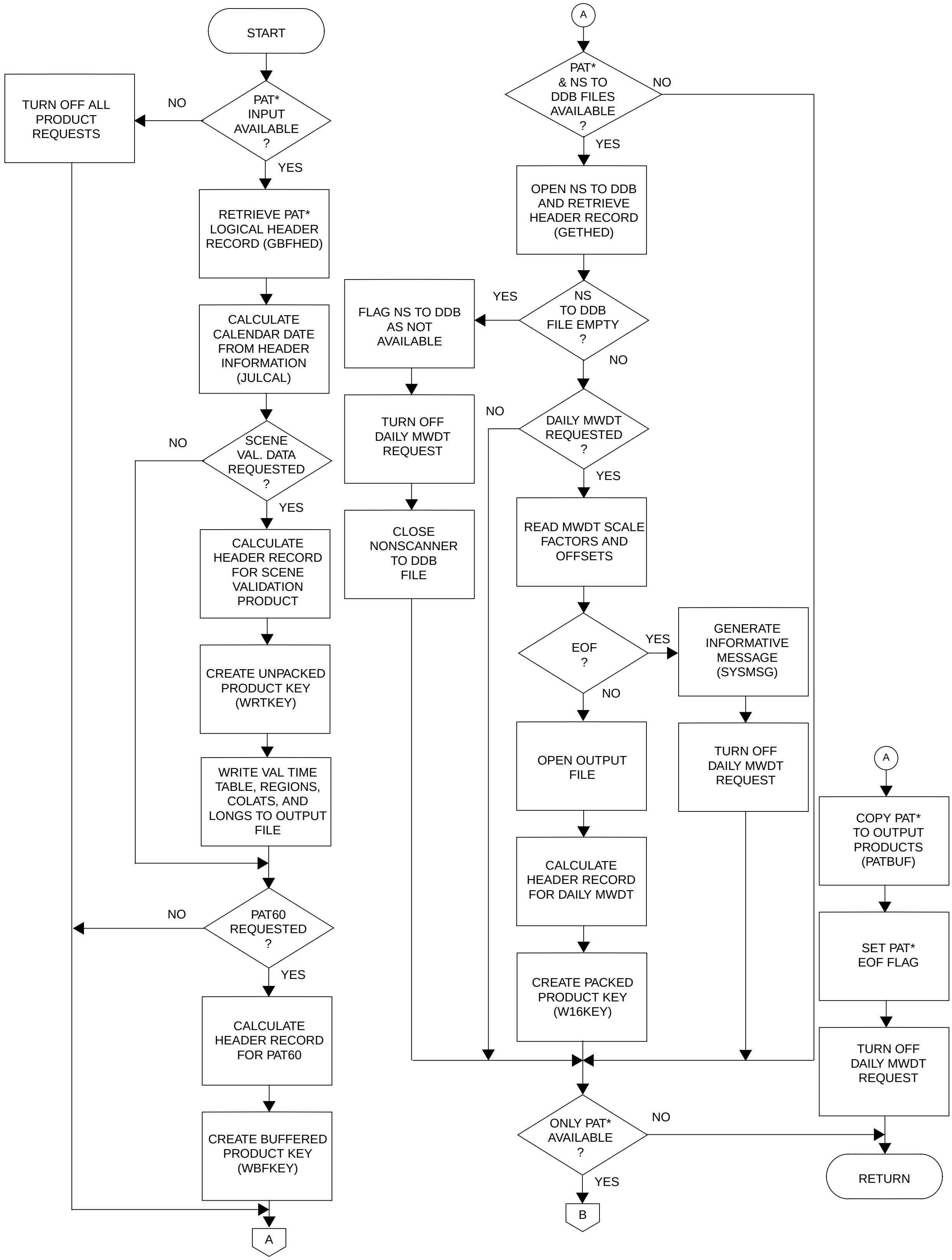


Figure 5.5-4. Flowchart of INITPP (Module 5.5.1)

5.5.2 DATA PROCESSING (DATRUN)

Subroutine DATRUN merges 16-set PAT* records with 32-sec nonscanner to DDB records to prepare the requested products (PAT60, daily MWDT, and/or the scene validation data). Each PAT60 data record is read (BUFFER IN) from the PAT* input file into the array, **XPAT**. For a successful read, the flag IRDFLG, is set to 1, indicating that PAT* data may be processed. IRDFLG will be set to 0 when an end-of-file is reached on the PAT*. The time of each PAT* record, TPAT, is calculated as a sum of the whole and fractional Julian dates.

DATRUN initially sets the nonscanner time to 0.0. Each time a PAT* record is buffered in, it is determined whether the time from the nonscanner record is less than TPAT. If so, the next nonscanner to DDB record is read and the nonscanner time calculated as the sum of the whole and fractional Julian dates. ID-7 records are read until the nonscanner time is not less than TPAT. If the nonscanner time is less than or equal to TPAT+16 seconds, then the nonscanner TOA estimates are loaded into the **XPAT**. Should an end-of-file be encountered on the nonscanner to DDB input file while there is still data on the PAT* file, subroutine PATBUF (#G.5.15) will copy the remaining PAT* records to the PAT60 and/or ID-4.

The daily MWDT data consist of subsets of **XPAT** which are loaded into the array, **XMWDT** (see Table B-5a). MWDT scale factors and offsets are applied to each element of the **XMWDT** array by subroutine DPACK (#G.5.16) according to the packing equation shown in Section A.8. STUFF (#G.E.8.6.16) packs the **XMWDT** array and loads the results into the **MWDPCK** array. The **MWDPCK** array is complete when MRECFR (equal to 20) records have been packed and loaded into it. This blocking process reduces the number of end-of-record marks that are written to the output file, thus saving space. When complete, this data block is written to the daily MWDT output file. Figure 5.5-5 illustrates the blocking process. If 20 MWDT data records have not been accumulated to completely fill the **MWDPCK** array at the time that an end-of-file is encountered on the PAT*, the unfilled portion is loaded with the default value, XERROR. The now completed data block is then written to the daily MWDT output file.

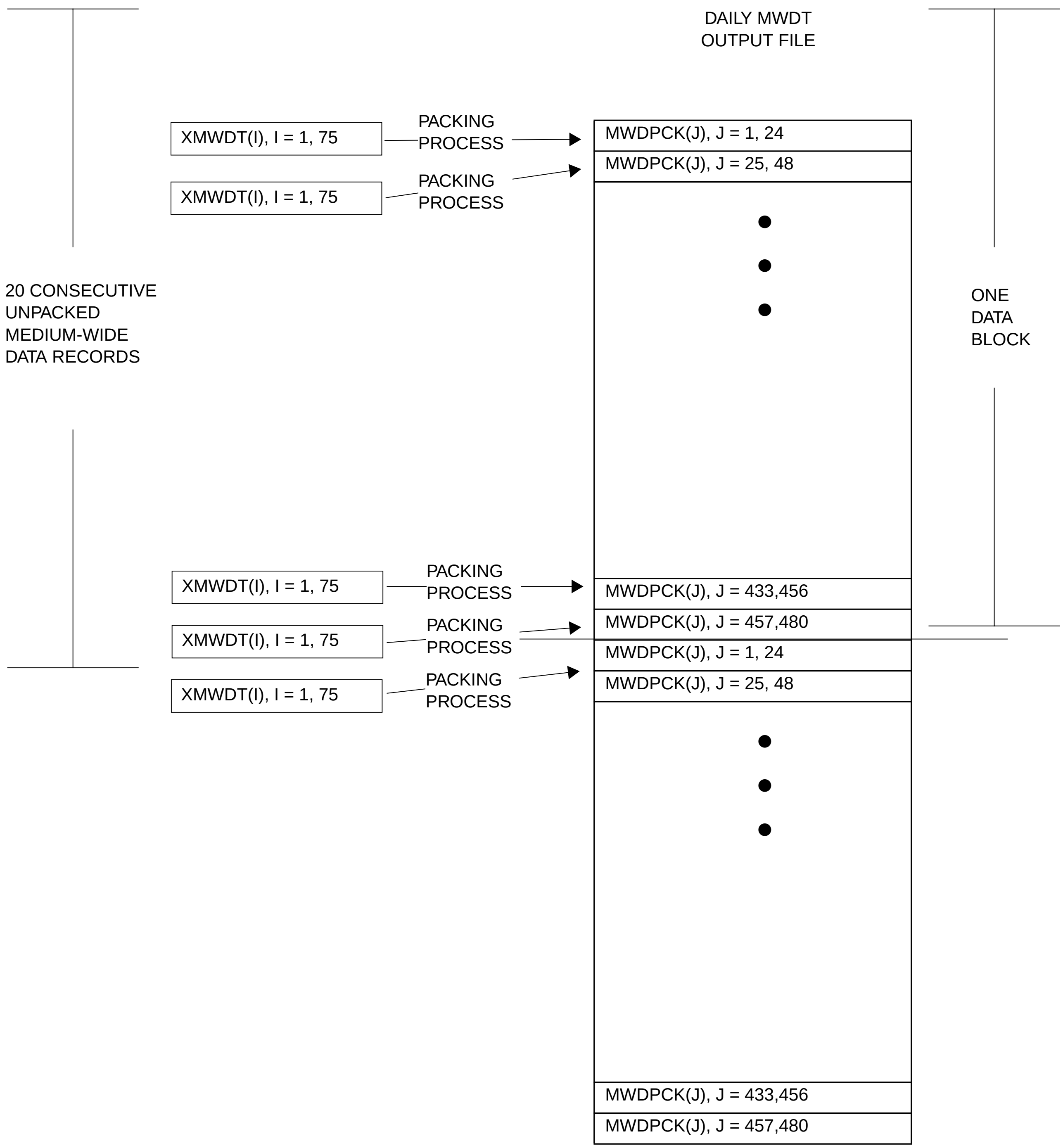


Figure 5.5-5. Medium-Wide Data Blocking Process

The ID-4 is generated by dumping PAT60 data records for which TPAT is included in one (or more) of the validation time periods (VTP) calculated by the Main-Processor in subroutine VALDAT (#5.1.3). The list of these validation time periods constitutes the Scene Validation Data Time Table which is passed to the Post-Processor in the NAMELIST $NVTOUT (see Table B-7). This time table contains region numbers, flags indicating ascending or descending node, and the start and stop times for each period (see Section B.8). The maximum number of validation time periods is defined by the parameter NDIM21. As processing of the data for each period is completed, the counter, ITT, is incremented by one. STOP, the parameter indicating the stop time for each time period, is initialized by the driver routine SIPOST as -9999. Its value changes with each new period that is encountered. Each ID-4 data record will contain a five element array, IVREG, of validation regions with time periods that include TPAT, the mode flag, TPAT, and the **XPAT** array. The structure for the Scanner and Nonscanner Scene Validation Data product is shown in Table B-2a.

Figure 5.5-6 is a flow diagram of subroutine DATRUN.

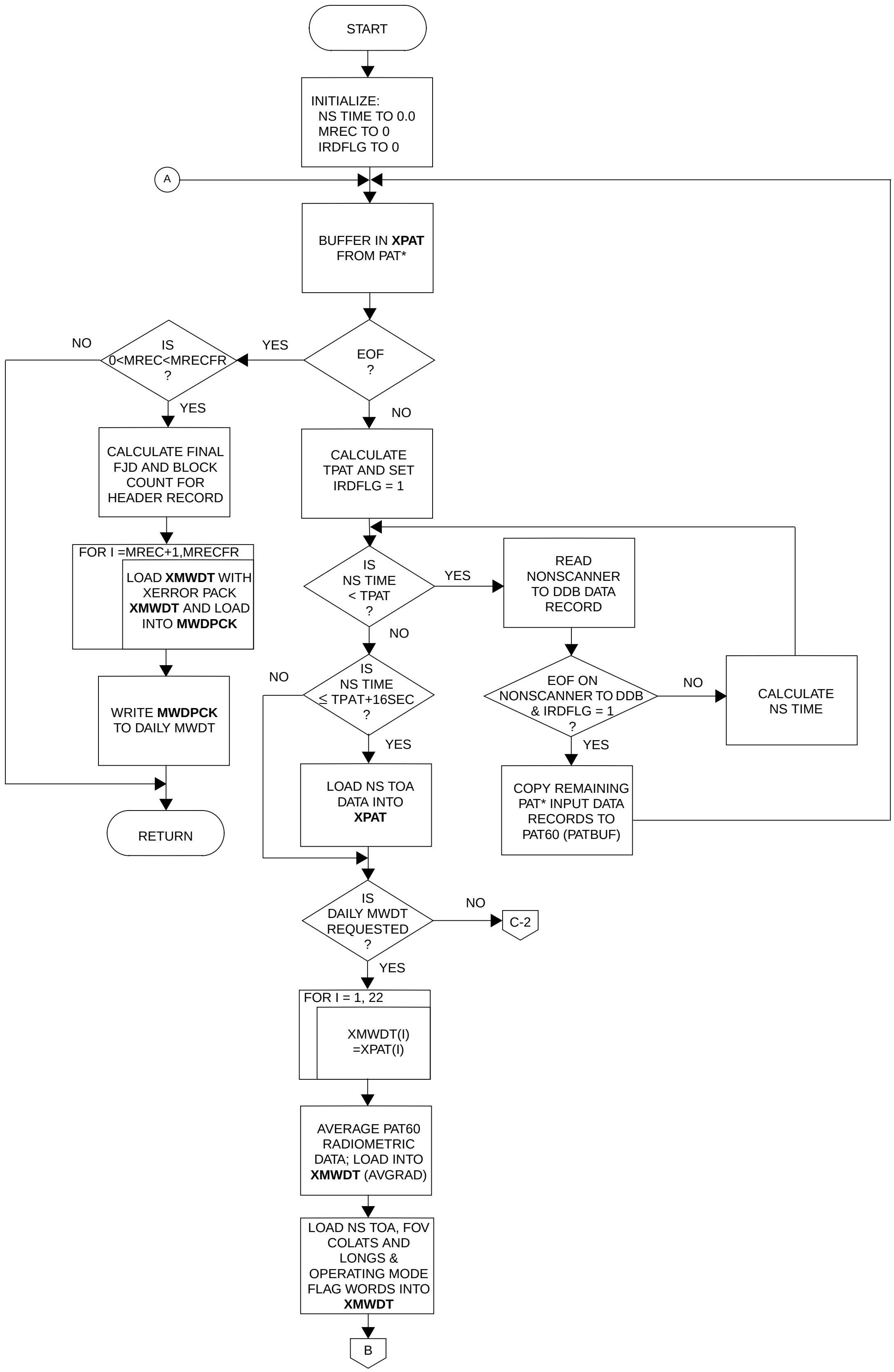


Figure 5.5-6. Flowchart of DATRUN (Module 5.5.2) (1 of 2)

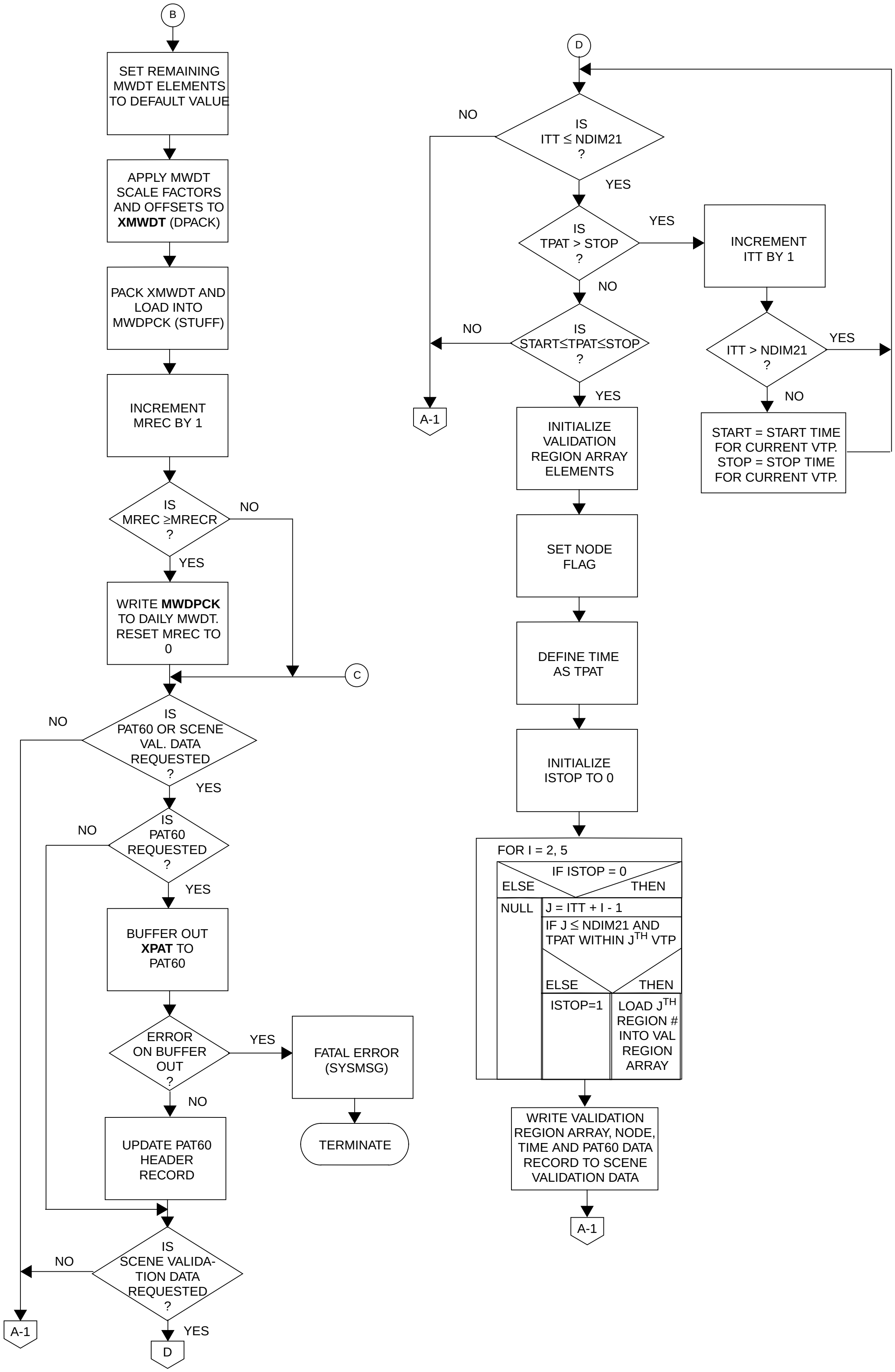


Figure 5.5-6. Flowchart of DATRUN (Module 5.5.2) (2 of 2)

5.5.2.1 Averaging Data (AVGRAD). Subroutine AVGRAD calculates the average of each of the 4 sets of nonscanner radiometric data from the input array, **XPAT**, and loads the averages into the output array, **XMWDT**. Each set has five values. If there are one to four default values (XERROR) in a set, the default values are excluded from the averaging. If all five values of a set are default values, then the average will be set equal to the default value, XER, the **XPAT** array, the initial value of the input array pointer, NPAT, and the initial value of the output array pointer, NMWD, are passed as arguments from the calling routine.

Figure 5.5-7 is a flowchart of AVGRAD.

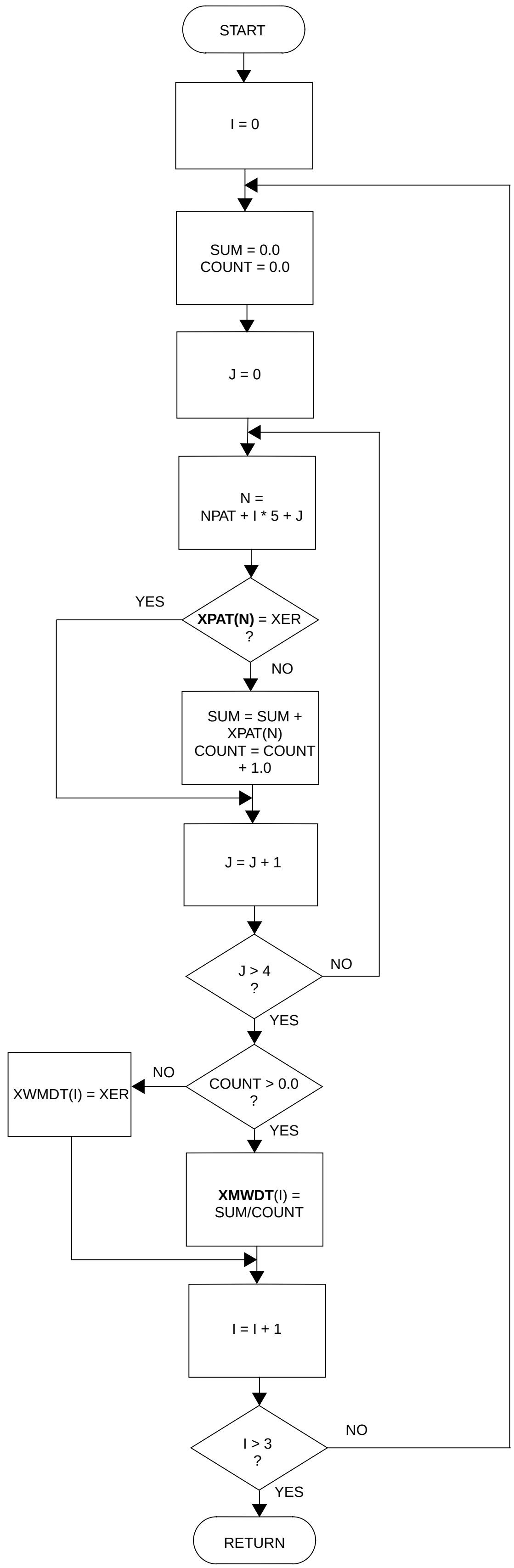


Figure 5.5-7. Flowchart of AVGRAD (Module 5.5.2.1)

5.5.3 INVERSION SUBSYSTEM POST-PROCESSOR PROCESSING SUMMARY (INPPPS)

Subroutine INPPPS generates the Inversion Subsystem Post-Processor processing summary report, QC-27. The first page of the two page report displays the data date, which output products were requested, and record counts for each output product. The second page lists the logical header records for all input and output files. The header records are also output to the ERBE error message report file, MSGUNT (see COMMON Block /GLOBAL/). Both pages contain the normal ERBE heading generated by calls to WRHDM (#G.E.8.6.2). The QC-27 report is illustrated in Figure B-3.

Figure 5.5-8 is a flowchart of INPPPS.

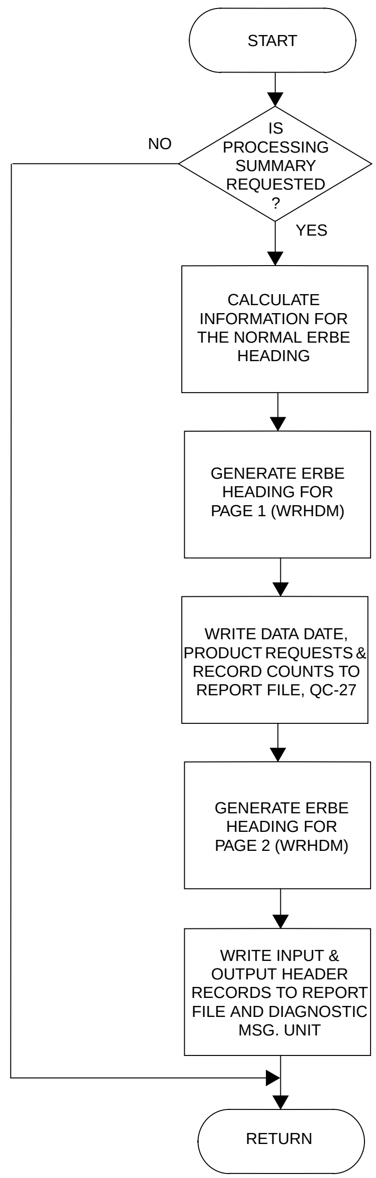


Figure 5.5-8. Flowchart of INPPPS (Module 5.5.3)

5.6 INVERSION SUBSYSTEM MONTHLY-PROCESSOR (SIMNTH)

The Inversion Subsystem Monthly-Processor merges daily input files to form either a Medium-Wide FOV Data Tape (MWDT, S-7) or an Earth Target Validation Data (ETVD, V-6) tape. When generating an S-7 tape, SIMNTH merges daily MWDT (ID-12) files. When generating a V-6 tape, daily ETVD (ID-13) files are merged. The daily MWDT files are generated by the Inversion Subsystem Post-Processor, and the daily ETVD files are generated by the Main-Processor. The daily files are named according to product, satellite, and data date and are stored as permanent files (see Appendix H for naming conventions). All of the data on a monthly tape are from the same month and satellite. New data for a given month and satellite may be merged with data on an existing tape. Record structure and content of the MWDT and ETVD output products are given in Tables B-5a and B-6a. Tables B-5b and B-6b are file structure charts for the S-7 and V-6.

A brief overview of the Monthly-Processor is presented below. Given the output product specifications (product, satellite, month and year), the associated job stream identifies and makes local all the permanent data files with names corresponding to these designations. The unit number assigned to each data file will match the day of the month of the data contained on that file. Daily files are then written chronologically to the output tape by the Monthly-Processor. The Monthly-Processor can be executed using input files for an entire month or a partial month.

The module SIMNTH drives processing for the Monthly-Processor. Parameters that remain constant throughout SIMNTH processing are read in from NAMELIST $NINVPP (see Table A-8h for definitions of these parameters), and ERBE System processing constants are read in from $NAMGLB (see Reference 5 for definitions of these parameters). Subroutine SPECS (#5.6.1) determines the specifications (month, year, satellite, and product) of the requested output product. Subroutine START (#5.6.2) then drives the merging of daily data files into a monthly product. To finalize processing, subroutine SUMMRY (#5.6.3) generates the processing summary report, QC-44, PUTHED (#G.E.8.3.7) updates the logical header file, and FINUTL (#G.E.8.2.2) terminates processing.

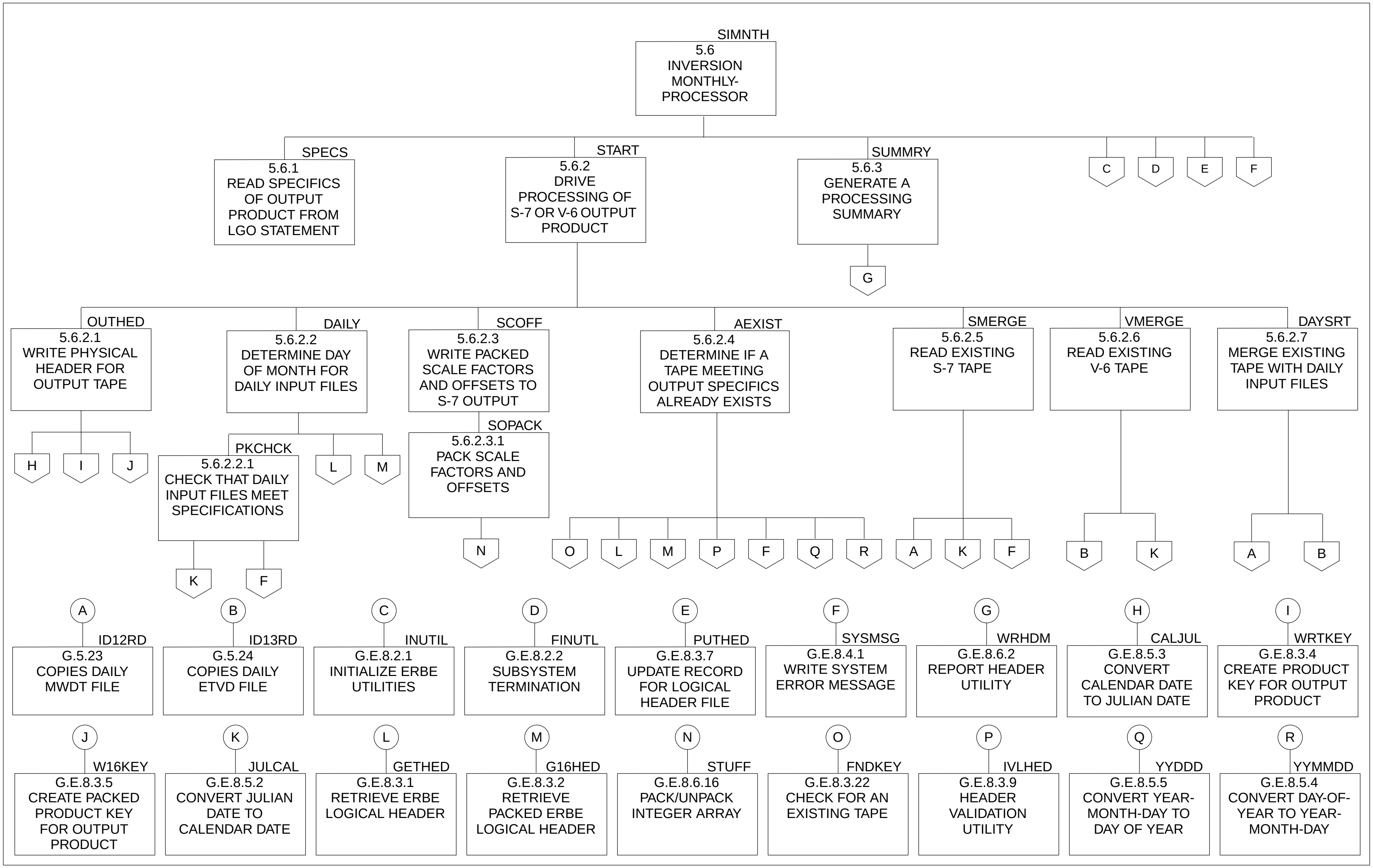


Figure 5.6-1. Inversion Subsystem Monthly-Processor Structure Diagram

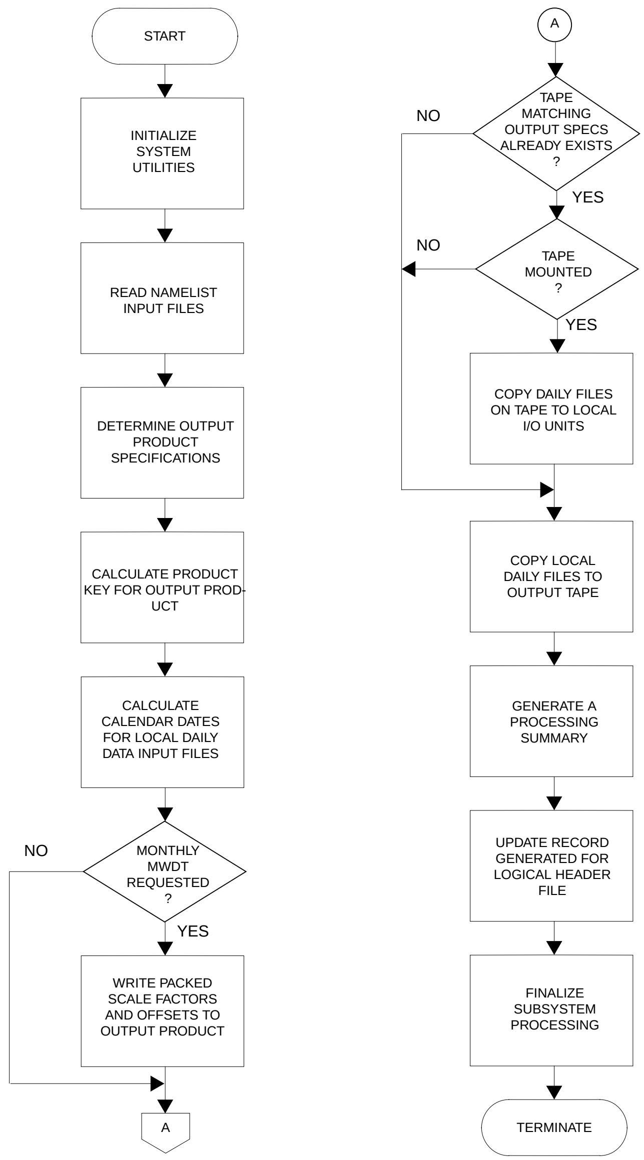


Figure 5.6-2. Inversion Subsystem Monthly-Processor Data Processing Flow

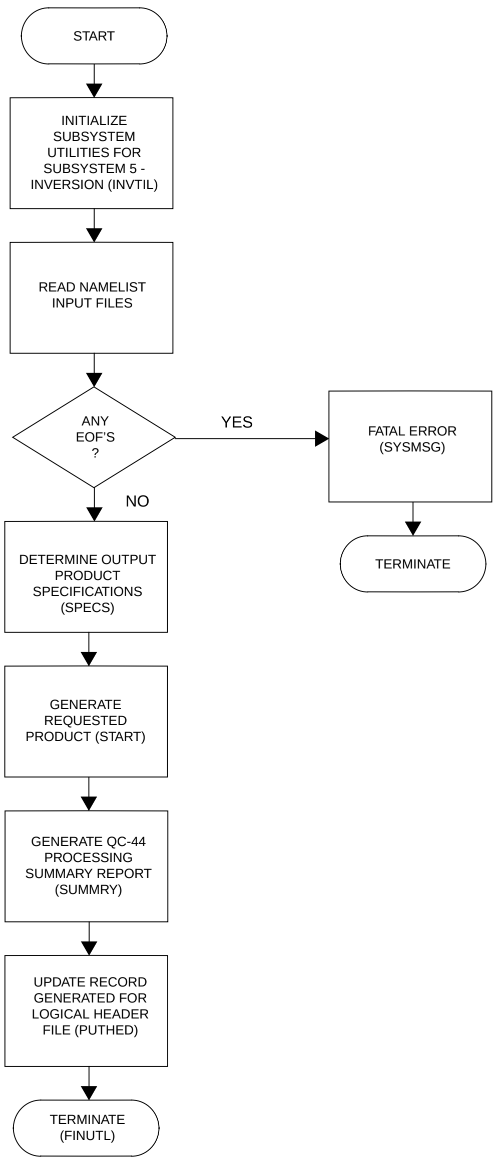


Figure 5.6-3. Flowchart of SIMNTH (Module 5.6)

Figure 5.6-1 shows the structure of the Inversion Subsystem Monthly-Processor, and Figure 5.6-2 illustrates the data processing flow. A flowchart of the module SIMNTH is given in Figure 5.6-3.

SIMNTH is executed in batch mode by the PIMNTH procedure on PINVSS, the Inversion Subsystem multiprocedure file. The user enters the year, month, satellite, and output product codes during interactive job submission (see Appendix H). PIMNTH includes the Cyber Control Language (CCL) FILE Command for both the input and output S-7 tapes. The FILE command is as follows,

```
FILE,lfn,BT=C,RT=S,MBL=4820
```

where lfn stands for local file name. See Reference 6 for information concerning the FILE command.

Detailed descriptions and flowcharts of the processing modules are contained in the following sections. For more information on the S-7 and V-6 see References 7 and 8.

5.6.1 DETERMINING SPECIFICATIONS FOR OUTPUT TAPE (SPECS)

Subroutine SPECS uses the CDC supplied FTN5 routine GETPARM to retrieve parameters from the execution control statement. These parameters include the output product requested and the month, year, and satellite of the data on the output product. SPECS checks to determine if the product, month, and satellite are valid. If any of these parameters are invalid, a fatal error exists, and SYSMSG (#G.E.8.4.1) terminates processing of the Monthly-Processor.

SPECS also defines the values for the daily and monthly product flags, IDPC and IMPC. These values are set according to the product codes for the products (see Table B-1). If the S-7 is requested, IDPC is set to 6 and IMPC to 9. For the V-6, IDPC is set to 7 and IMPC to 10. Figure 5.6-4 is a flowchart of subroutine SPECS.

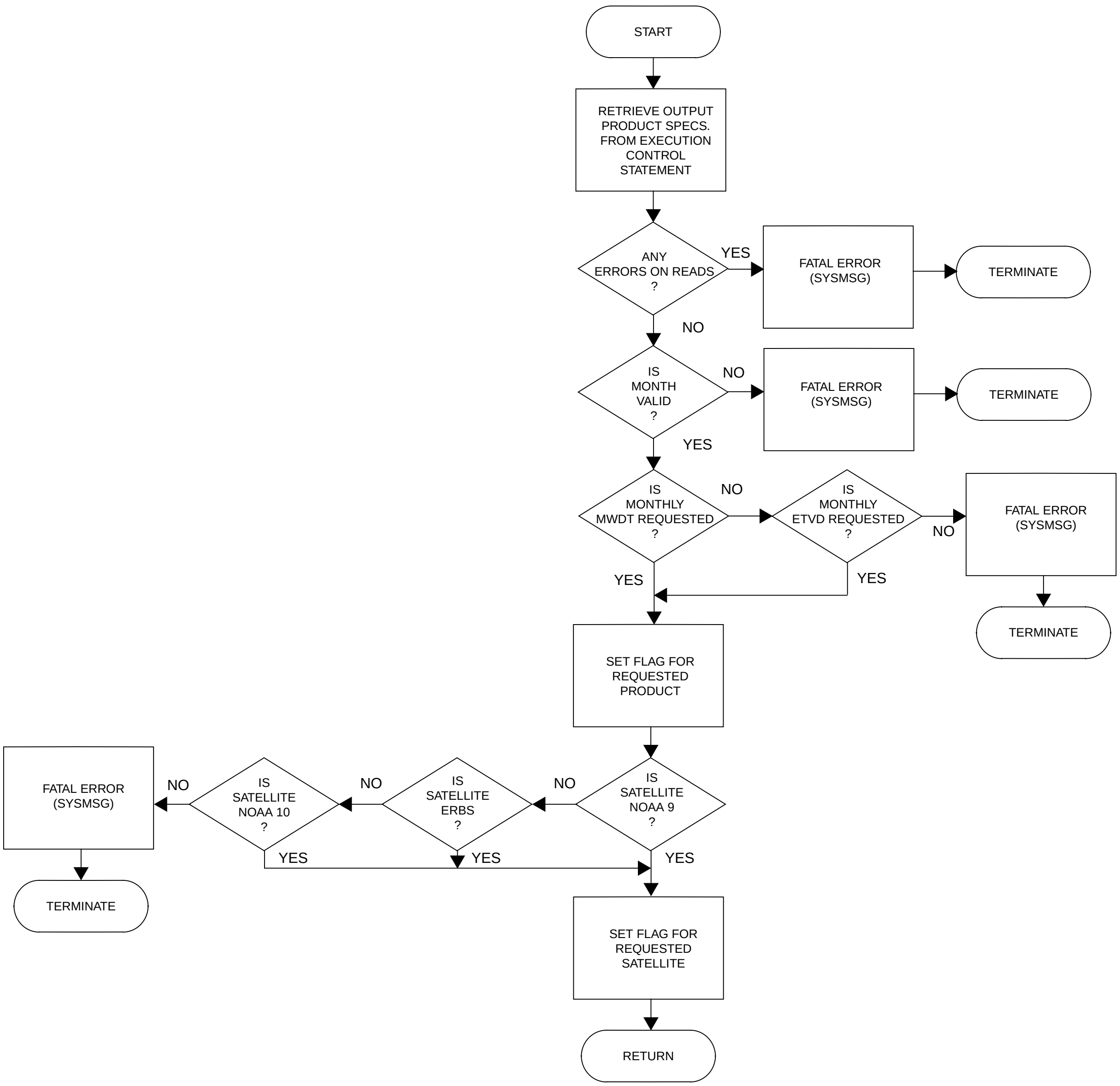


Figure 5.6-4. Flowchart of SPECS (Module 5.6.1)

5.6.2 INVERSION SUBSYSTEM MONTHLY-PROCESSOR DRIVER (START)

Subroutine START drives the Monthly-Processor in the generation of the requested product. The product key for the output tape is generated by a call to OUTHED (#5.6.2.1). Next subroutine DAILY (#5.6.2.2) reads past the headers of the daily data input files, so that the files are in position to be written to the output tape. If the monthly MWDT is requested, SCOFF (#5.6.2.3) is called to process scale factors and offsets. A call to subroutine AEXIST (#5.6.2.4) determines if an input tape meeting the output product specifications already exists, and whether or not it has been mounted. If an S-7 tape exists, SMERGE (#5.6.2.5) is called, otherwise VMERGE (#5.6.2.6) is called. Both SMERGE and VMERGE copy the daily files from the input tape to individual local files. Finally, subroutine DAYSRT (#5.6.2.7) is called to copy the local daily data files to the output tape. Figure 5.6-5 is a flowchart of subroutine START.

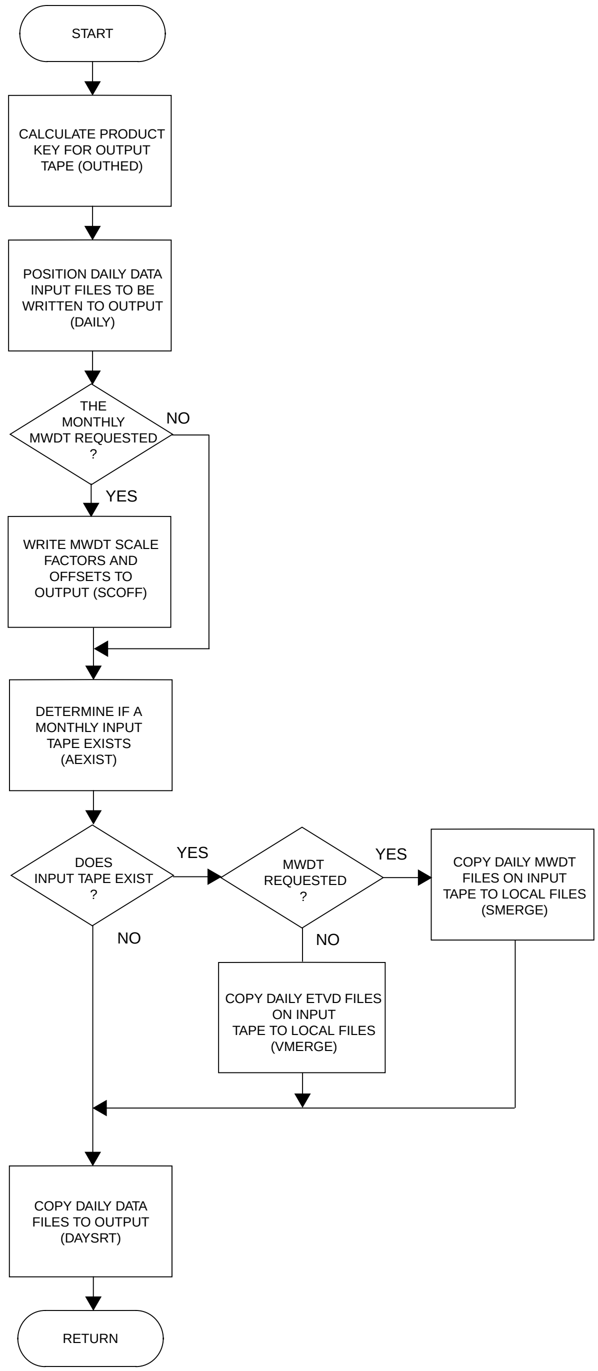


Figure 5.6-5. Flowchart of START (Module 5.6.2)

5.6.2.1 Output Header Generation (OUTHED). Subroutine OUTHED generates the logical header record for the requested output product and writes the physical header to the output tape. The calendar dates for the beginning and end of the given month are converted to Julian dates. The logical header record elements corresponding to the beginning and ending dates are then defined. The beginning date for a month is defined as 0000 hours, Greenwich Mean Time (GMT), of the first day of that month. The ending date is defined as 16 seconds before 0000 hours, GMT, of the first day of the immediately following month. The element of the header record corresponding to the satellite code is defined according to the specifications determined by SPECS (#5.6.1). Once the dates and satellite code have been defined, the product key is written. Figure 5.6-6 is a flowchart of subroutine OUTHED.

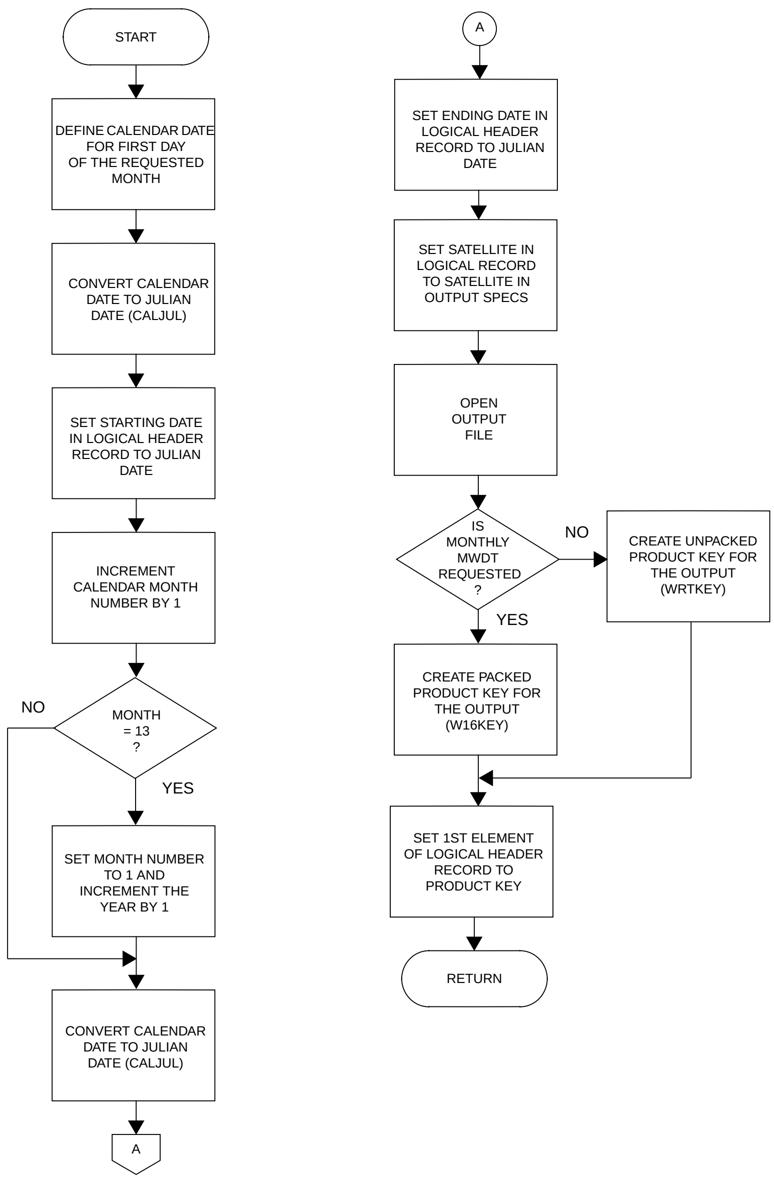


Figure 5.6-6. Flowchart of OUTHED (Module 5.6.2.1)

5.6.2.2 Determining Which Days are Available for Output (DAILY). DAILY determines the days of the month for which there are new daily data input files and positions these files to be copied to the output tape. The input and output unit numbers for these files are the same as the days of the month of the data they contain. Each unit is opened in chronological order, and the first record is read. If there is no data for a day, an end-of-file is immediately encountered, and the next unit is opened and read. If an end-of-file is not encountered on the first record, a flag is set to indicate that new data is available for that day. The header on the daily data file is then read by a call to GETHED (#G.E.8.3.1) for daily ETVD files or by a call to G16HED (#G.E.8.3.2) for daily MWDT files, leaving the file in position to be copied to the output tape. On successful reads, subroutine PKCHCK (#5.6.2.2.1) is called to verify that the daily data input file matches the output product specifications. Figure 5.6-7 is a flowchart of subroutine DAILY.

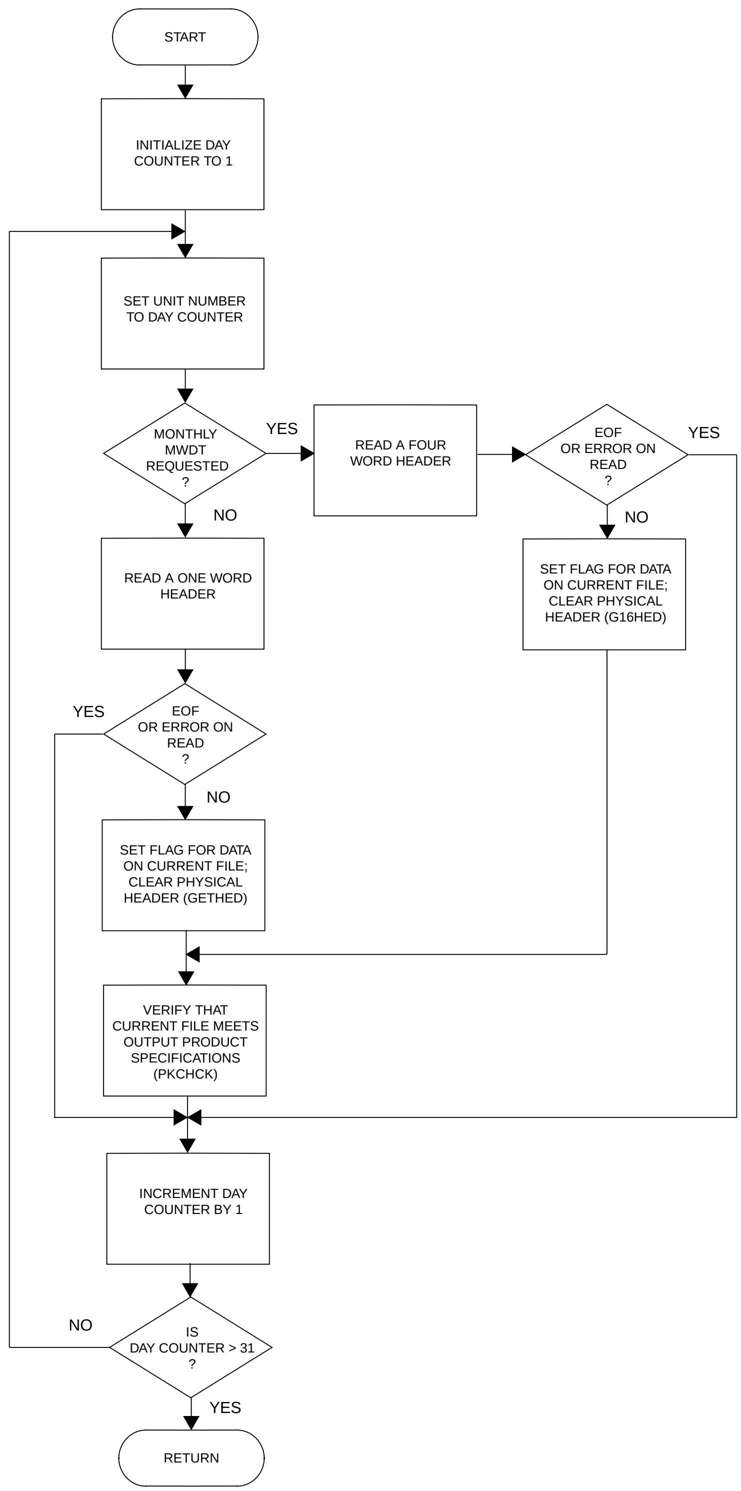


Figure 5.6-7. Flowchart of DAILY (Module 5.6.2.2)

5.6.2.2.1 Verification of Daily Input Data Files (PKCHCK). Subroutine PKCHCK uses the logical header record retrieved by DAILY (#5.6.2.2) to determine whether or not a daily data input file meets the output product specifications determined in subroutine SPECS (#5.6.1). The product code for the daily file is extracted from the product key and the file is verified as either a daily MWDT data file or a daily ETVD data file. The satellite identification element of the header record is compared to the output specifications. Beginning and ending Julian dates provided by the header array are converted to calendar dates and the month and year compared against output specifications. Should any comparison fail, a fatal error exists, and SYSMSG (#G.E.8.4.1) is called to terminate processing of the Monthly-Processor. Figure 5.6-8 is a flowchart of subroutine PKCHCK.

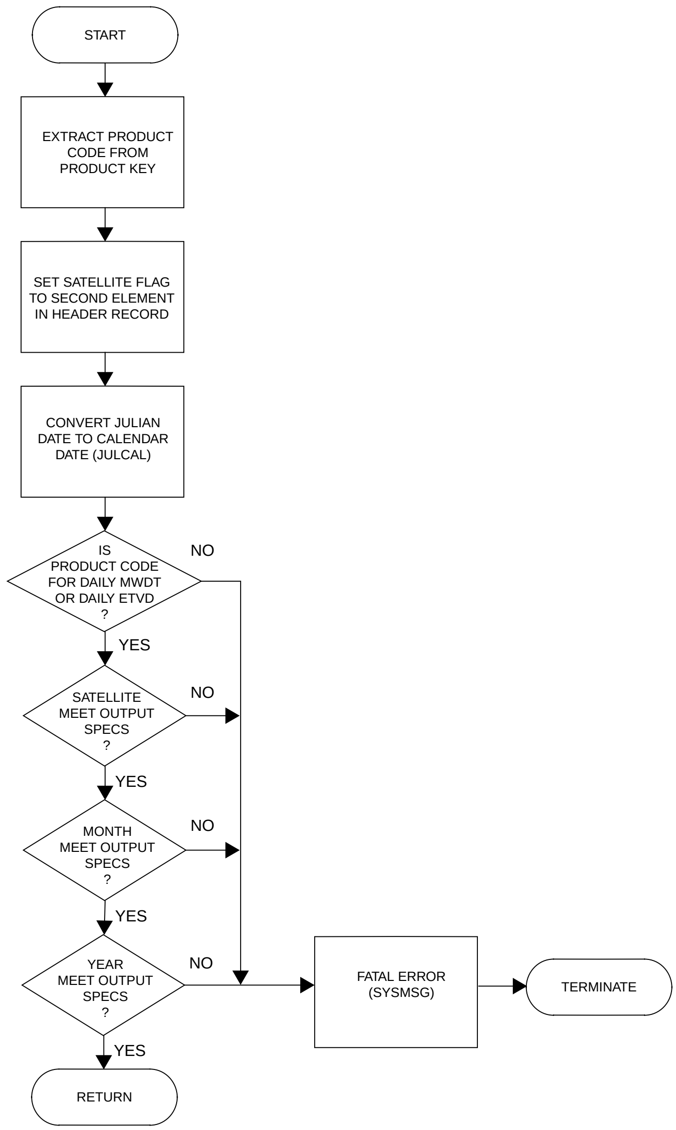


Figure 5.6-8. Flowchart of PKCHCK (Module 5.6.2.2.1)

5.6.2.3 Writing Scale Factors and Offsets to Output (SCOFF). SCOFF reads an input file containing unpacked MWDT scale factor and offset records (see Section A.8 for a discussion of the generation and use of scale factors and offsets). An error encountered while reading either record results in a fatal error, and SYSMSG (#G.E.8.4.1) is called to terminate processing of the Monthly-Processor. Subroutine SOPACK (#5.6.2.3) is called to pack the scale factors which are then written to the monthly MWDT and is called again to pack the offset record, also written to the output product. Figure 5.6-9 is a flowchart of subroutine SCOFF.

5.6.2.3.1 Packing Scale Factors and Offsets (SOPACK). Subroutine SOPACK converts an array of 75 real elements to integer values using the FTN5 intrinsic function, NINT. STUFF (#G.E.8.6.16) is then called to pack the resulting integer array into 24 60-bit words.

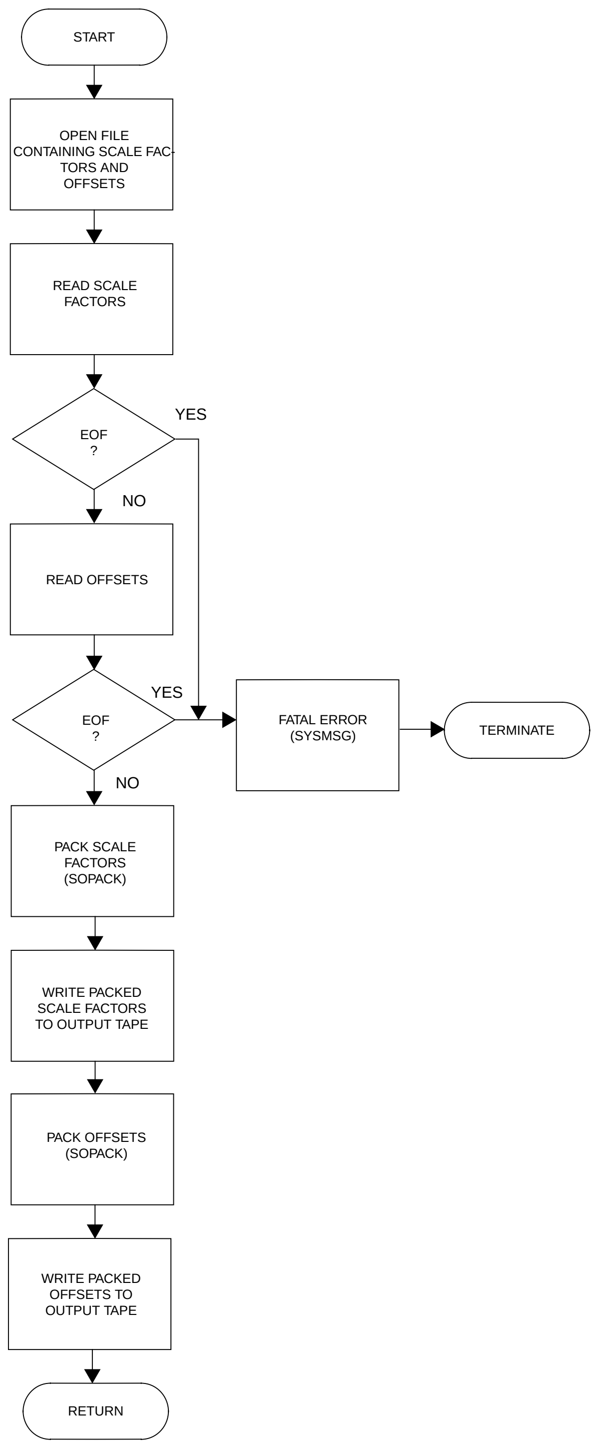


Figure 5.6-9. Flowchart of SCOFF (Module 5.6.2.3)

5.6.2.4 Determining Whether a Tape Already Exists (AEXIST). Subroutine AEXIST uses the CDC supplied FTN5 routine GETPARM to retrieve the VSN of the input tape from the execution control statement. If the VSN is equal to NREQ (see Section H.2), then no input tape was mounted. AEXIST then determines if an output tape meeting the specifications of the output product already exists by using the function FNDKEY (#G.E.8.3.22). If FNDKEY returns a value of TRUE, indicating that a tape does exist but that the VSN for the input tape is equal to NREQ, an informative message is generated by SYSMSG (#G.E.8.4.1).

If a tape does already exist and the input tape VSN is not equal to NREQ, IVLHED (#G.E.8.3.9) is called to verify that the data on the input tape meets the specifications of the requested output product. Mounting the wrong input tape is a fatal error, and SYSMSG will terminate processing. The daily data files on the input tape will be merged with the new daily data input files to produce the requested output product. Figure 5.6-10 is a flowchart of subroutine AEXIST.

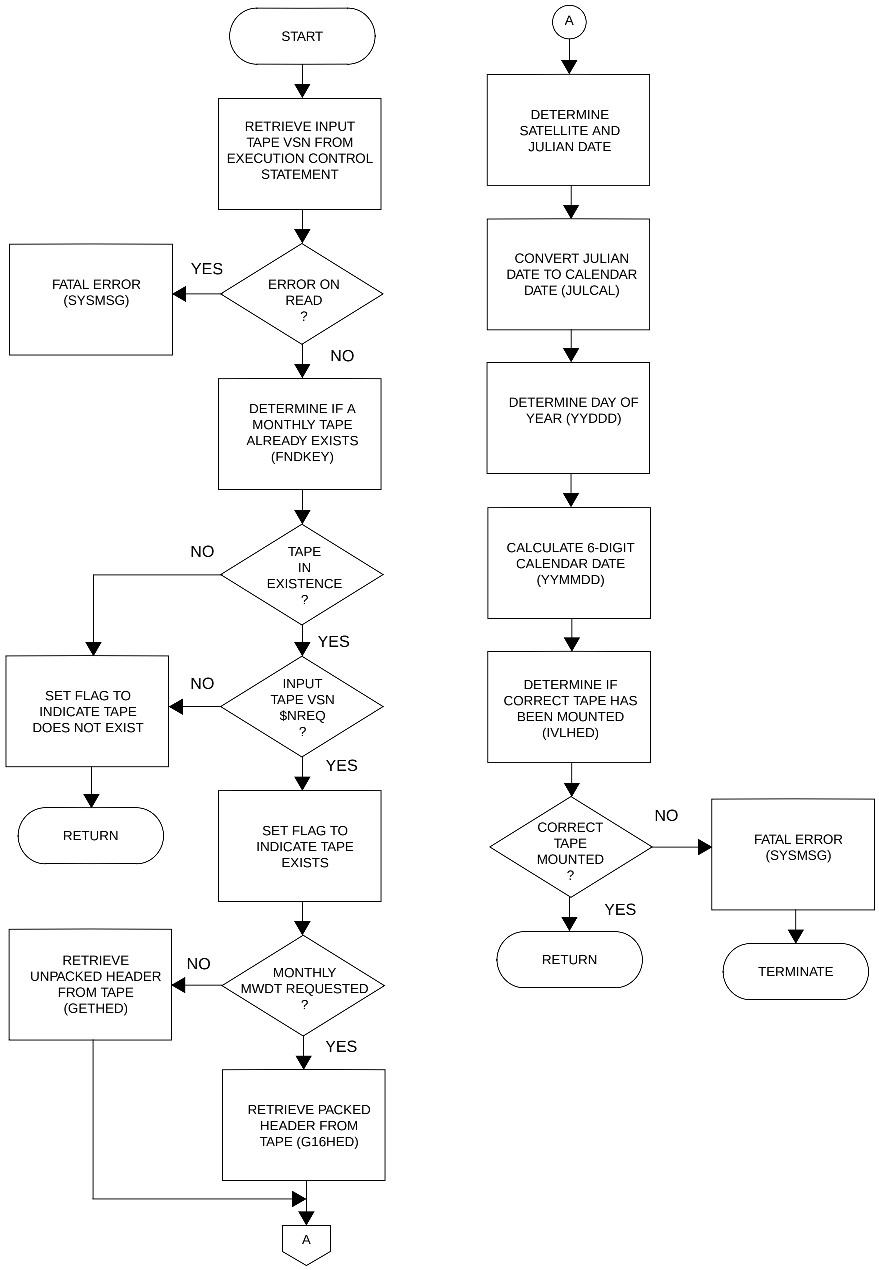


Figure 5.6-10. Flowchart of AEXIST (Module 5.6.2.4)

5.6.2.5 Reading an Existing S-7 Tape (SMERGE). SMERGE reads the daily data files on an existing S-7 tape and copies them to individual files. First the scale factor and offset records are read with any errors resulting in the termination of the Monthly-Processor by SYSMSG (#G.E.8.4.1). The first data block of each file on the tape is unpacked by subroutine STUFF (#G.E.8.6.16). The calendar date of the data is then determined by applying the appropriate scale factors and offsets (see Section A.8) to the data elements corresponding to the whole and fractional Julian dates. If there is not a new daily data input file to replace data for that day, the file is copied from the input tape to a local output file, TAPEn, where n is equal to the day of the month of the data. If there is a new ID-12 file for that day, the file on the input tape is skipped by reading it but not copying it to a local file. The new data will be written to the output tape instead of the old data.

Flags are set to indicate which of the daily files on the input tape will be copied to the output tape by subroutine DAYSRT (#5.6.2.7) and which files will be replaced with new data. Figure 5.6-11 is a flowchart of subroutine SMERGE.

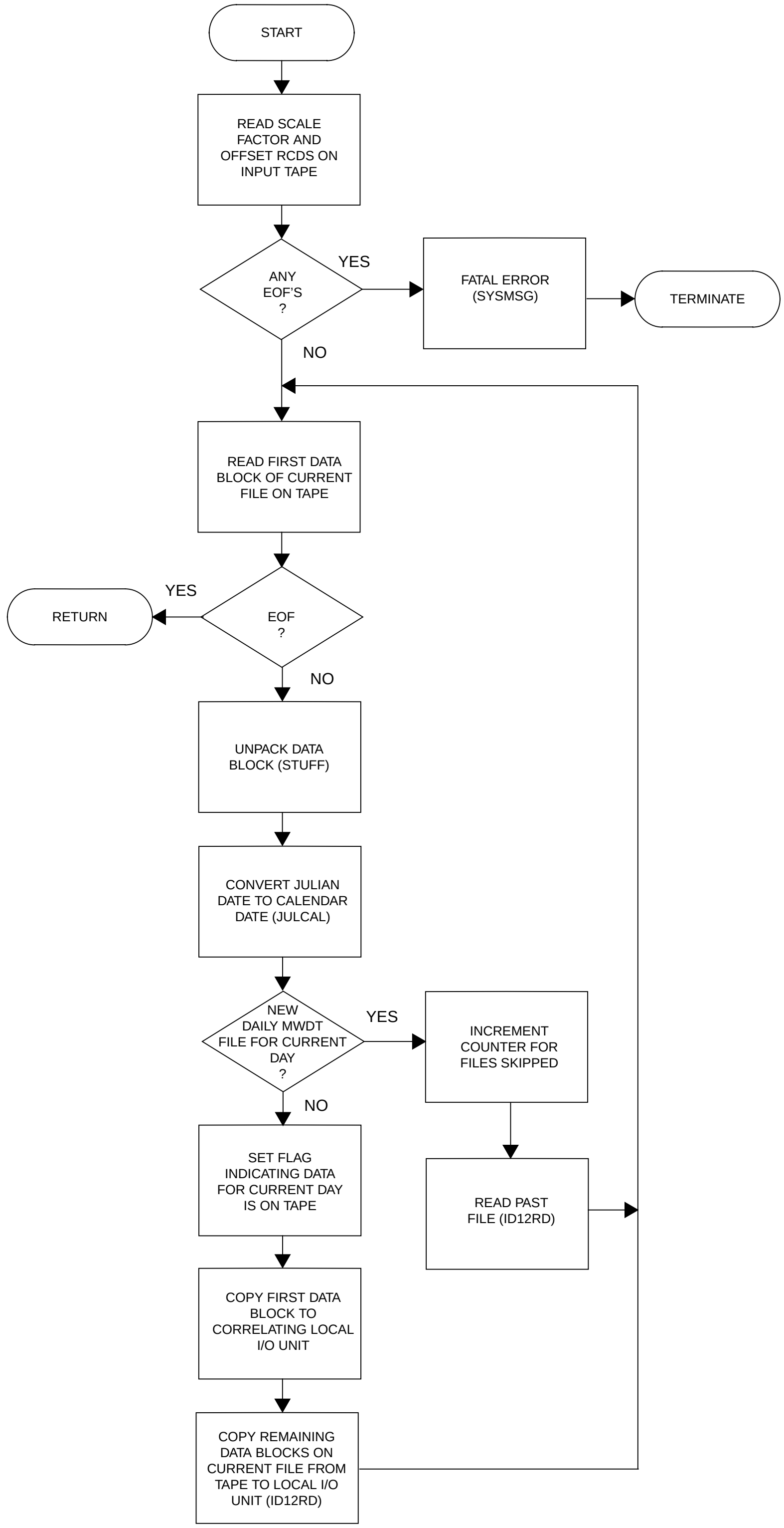


Figure 5.6-11. Flowchart of SMERGE (Module 5.6.2.5)

5.6.2.6 Reading an Existing V-6 Tape (VMERGE). VMERGE reads the daily data files (ID-13) on an existing monthly ETVD tape and copies them to individual files. The first record of each daily data file is read, and the calendar date of the data is determined. If no new daily file is available for that day of the month, the file is copied from the input tape to a local output file, TAPEn, where n is equal to the day of the month of the data. If there is a new ID-13 for that day, the file on the input tape is skipped by reading it but not copying it to a local file. The new data file will be written to the output tape instead of the old data.

Flags are set to indicate which daily data files on the input tape will be written to the output tape by subroutine DAYSRT (#5.6.2.7) and which files will be replaced by new data. Figure 5.6-12 is a flowchart for subroutine VMERGE.

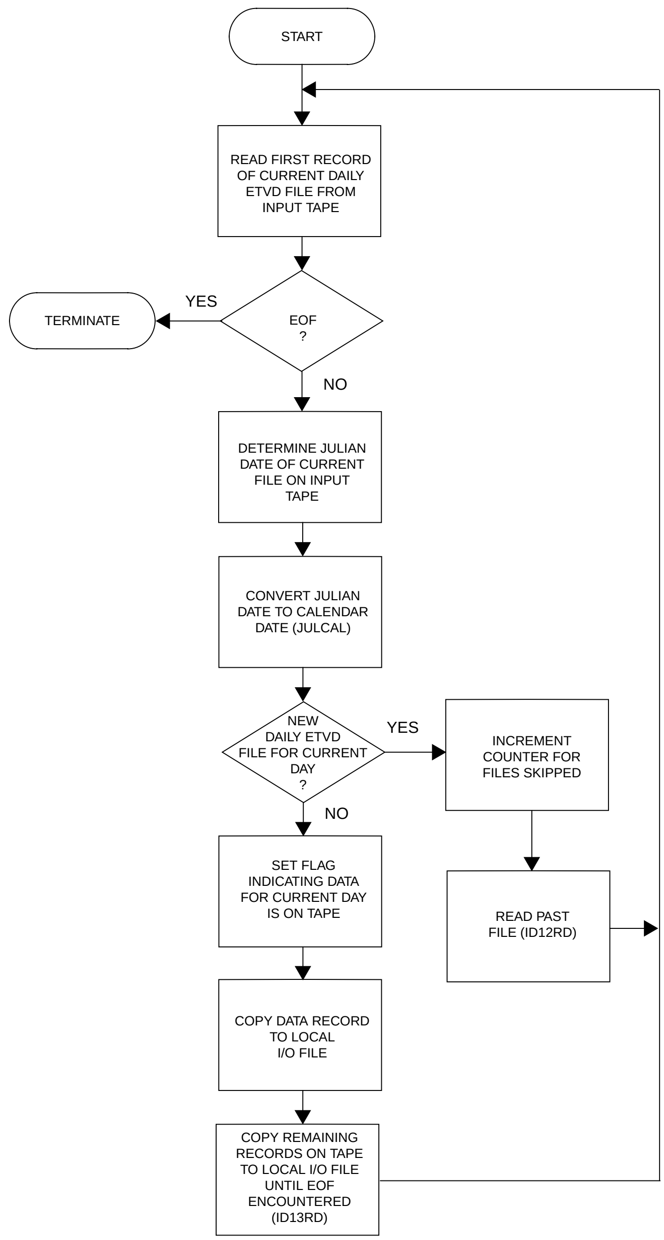


Figure 5.6-12. Flowchart of VMERGE (Module 5.6.2.6)

5.6.2.7 Copying Daily Data Files to the Output Tape (DAYSRT). Subroutine DAYSRT checks a flag for each day of the month to determine availability of daily data files. These flags were set by DAILY (#5.6.2.2), SMERGE (#5.6.2.5), or VMERGE (#5.6.2.6). The available daily data files are copied to the requested monthly output product in chronological order. Files retrieved from an existing monthly tape must be rewound before being copied. Counts for both the new daily data input files and the total daily data files written to the output tape are accumulated and later printed in the Processing Summary Report (QC-44). Figure 5.6-13 is a flowchart of subroutine DAYSRT.

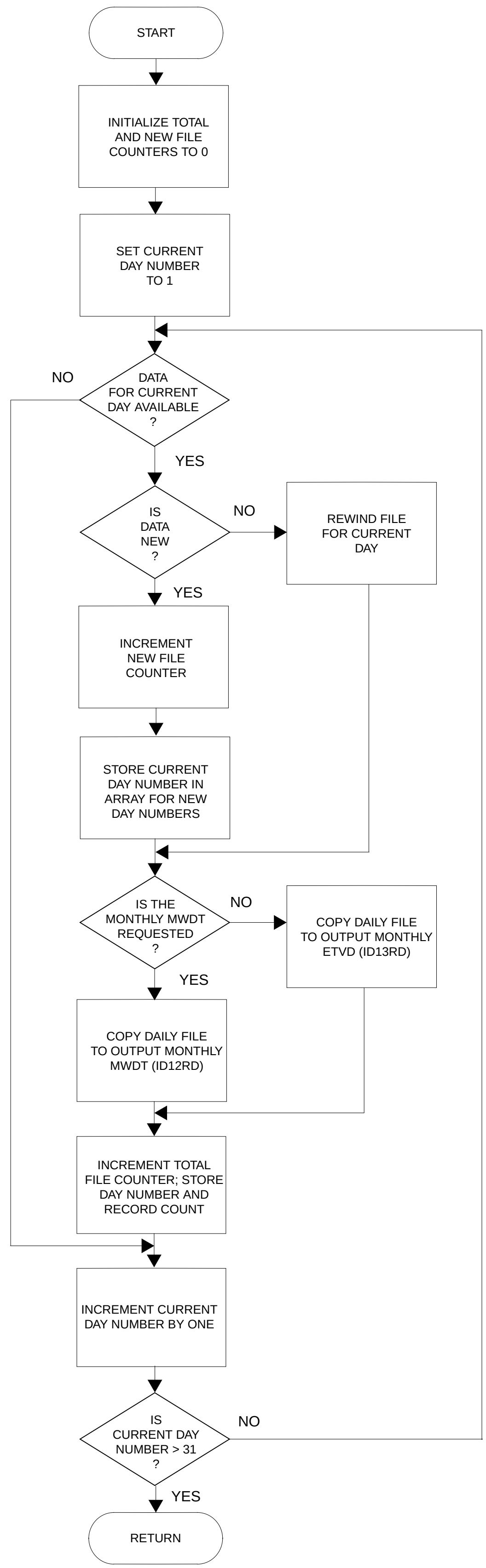


Figure 5.6-13. Flowchart of DAYSRT (Module 5.6.2.7)

5.6.3 INVERSION SUBSYSTEM MONTHLY-PROCESSOR PROCESSING SUMMARY (SUMMRY)

SUMMRY generates a two page processing summary report (QC-44) for the Monthly-Processor. A sample of the QC-44 report is given in Figures B-4a and B-4b. The first page includes which days of the month have data files on the output tape, which daily files are new, and which previously existing daily files were replaced with new data. A record count for each file is also given. The second page includes the logical header records for the input and output tapes. If no input tape exists, then the header record for the last daily data input file will be listed. Both pages of the report contain the normal ERBE heading as generated by WRHDM (#G.E.8.6.2). Figure 5.6-14 is a flowchart of subroutine SUMMRY.

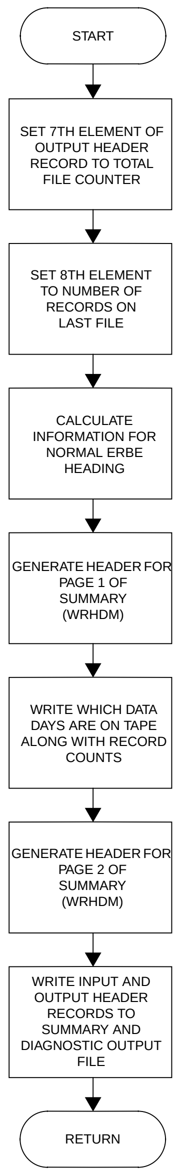


Figure 5.6-14. Flowchart of SUMMRY (Module 5.6.3)

5.7 INVERSION SUBSYSTEM PACKING PROGRAMS

Section 5.7 contains narratives, functional structure diagrams, and flowcharts of software for packing the unpacked Processed Archival Tape (PAT60, ID-24) product and the Scanner and Nonscanner Scene Validation Data product (scene validation data, ID-4).

See Section A.8 for packing equation.

5.7.1 PAT60 (ID-24) PACKING (SIPI24)

Program SIPI24 generates the Processed Archival Tape (PAT, S-8) from the PAT60 (ID-24). The PAT60, generated by the Inversion Subsystem Post-Processor, is merged with a sample test record and scaling values to create the PAT, a multifile product consisting of a standard ERBE header, test record, scale factors and offsets, and PAT data records. The packed data records each contain 912 words and are comprised of 32-bit, 16-bit, 8-bit and 4-bit data values. Figure 5.7-1 contains the PAT60 packing functional structure chart. The flowchart of program SIPI24 is shown in Figure 5.7-2. Table B-8b describes the structure of the PAT product. For a complete description of the structure and constants of the PAT data records, refer to the PAT Users' Guide (see Reference 9).

PAT60 packing logic is comprised of four main steps. First, a standard ERBE header is generated for and written to the PAT product. A test record is then processed, packed, and written to tape, followed by packed scale factors and offsets. Finally, unpacked PAT records are sequentially processed, packed and written to tape. The following steps describe in detail the PAT60 packing logic.

The generation of the S-8 product begins with a call to INUTIL (#G.E.8.2.1) to initialize system utilities. NAMELIST file $NIPUO1, containing unit numbers and subsystem constants is then read; refer to Table A-8i for the structure and contents of $NIPUO1. Next, scale factors, offsets, and a test record are read into local arrays. ERBE header processing follows. Routine GBFHED (#G.E.8.3.19 is invoked to retrieve the PAT60 logical header. A call to PPSPEC (#G.5.20) is then made to print out the PAT60 product specifications. Specifications include the following characteristics of the data: temporal span, spacecraft name, product name, volume serial number associated with the PAT60 product, and the contents of the ERBE logical header. Next, W16KEY (#G.E.8.3.5) is invoked to create a product key for the PAT product and to write a physical header record, followed by an end-of-file mark, onto the PAT tape.

Test record processing begins by calling DPACK (#G.5.16) to apply scale factors and offsets to test record elements. Next, STUFF (#G.E.8.6.16) is

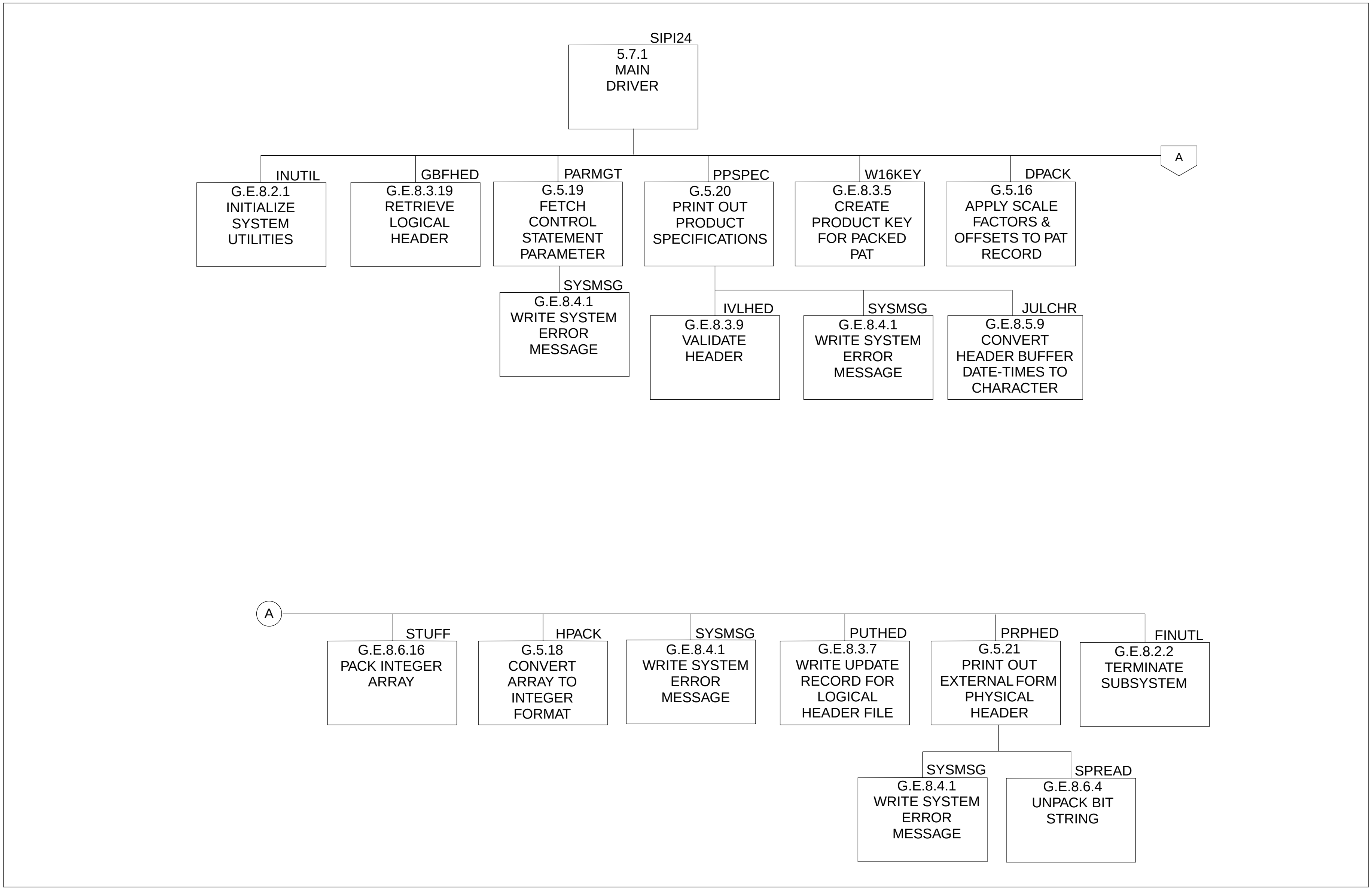


Figure 5.7-1. PAT60 Packing Program Functional Structure Chart

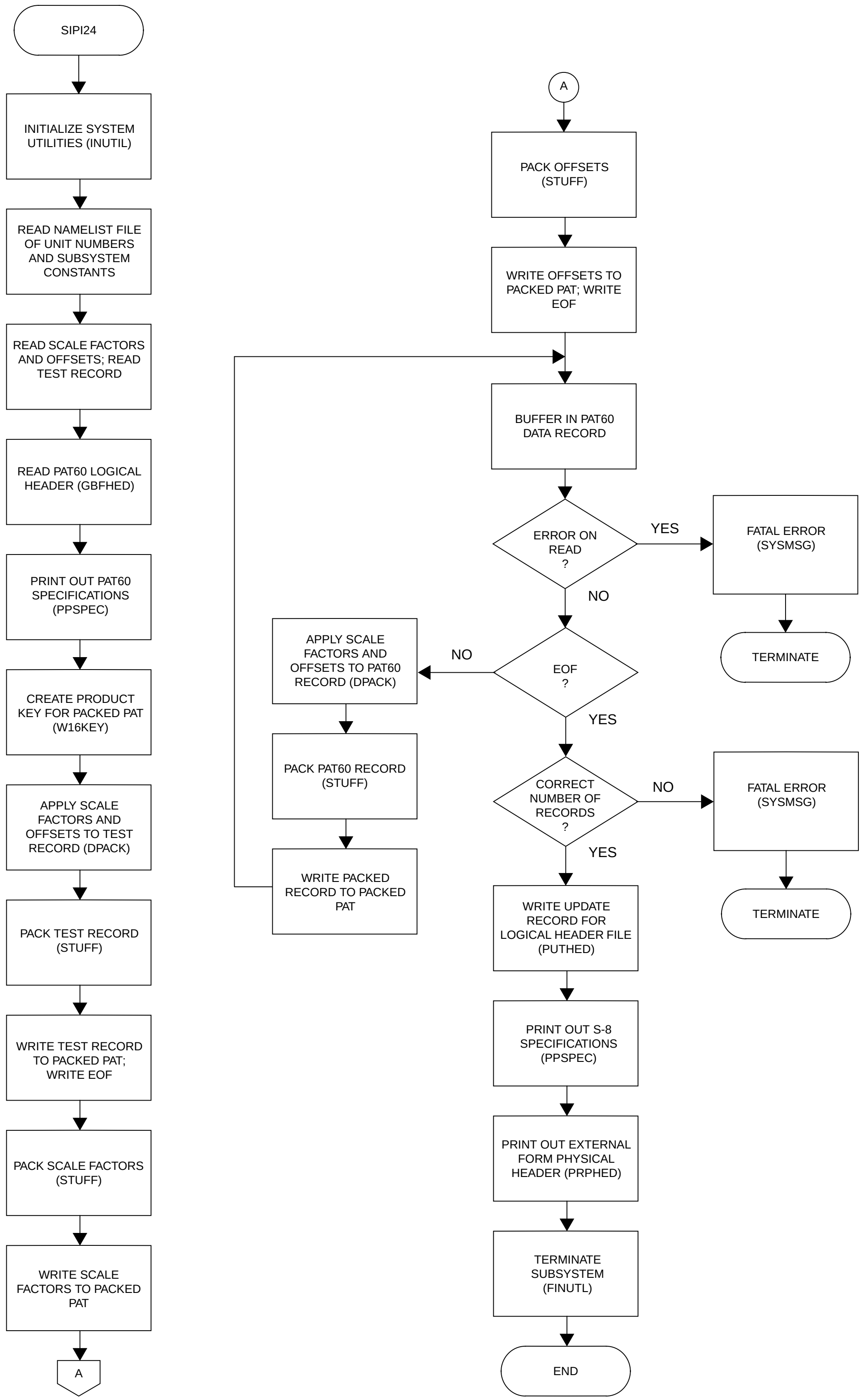


Figure 5.7-2. Flowchart of SIPI24 (Module 5.7.1)

invoked to pack the 3630 record elements into a 912 word array. The test record is then written to tape and is followed by an end-of-file mark.

Scale factors and offsets comprise the next file on the PAT product. The scale factor array is converted to integer format through a call to HPACK (#G.5.18). STUFF is then invoked to pack the scale factors, and the scale factors are written to tape. Offset processing is identical to scale factor handling. HPACK is invoked to convert offsets to an array in integer format, STUFF is invoked to pack the offsets, and the offsets are written to tape, followed by an end-of-file mark.

Program SIPI24 constructs the fourth file by iteratively processing the unpacked PAT data records as follows: an unpacked data record is buffered into a local array. DPACK is invoked to apply scale factors and offsets to the data record elements. A call to STUFF is then made to pack the data record into a 912 word array. The packed record is then written to tape. Once all unpacked data records are processed, packed, and written to tape, a call to PUTHED (#G.E.8.3.7) is made to write an update record for the logical header file for the PAT product; PPSPEC is then invoked to print S-8 product specifications. Finally, FINUTL (#G.E.8.2.2) is invoked to terminate processing.

Note that the following FILE statement is used in the job stream to define file characteristics for the S-8 product.

```
FILE,TAPE101,RT=S,BT=C,MBL=9120
```

For a complete description of the FILE statement and how it is used to redefine system default values see Reference 6.

5.7.2 SCENE VALIDATAION DATA (ID-4) PACKING (SIPI4)

Programs SIPI4 generates the packed Scanner and Nonscanner Scene Validation Data (packed scene validation data, ID-25) from the corresponding unpacked product (ID-4) which is generated by the Inversion Subsystem Post-Processor. The resultant ID-25 product contains a standard ERBE header, validation time and region information, packed scale factors and offsets, and a set of packed data records. Each data record contains seven words of region information, followed by a PAT record. Each PAT record contains 912 words and is comprised of 32-bit, 16-bit, 8-bit and 4-bit data values. Figure 5.7-3 contains the scene validation data packing functional structure chart. The flowchart of SIPI4 is shown in Figure 5.7-4. Table B-2b describes the structure of the ID-25 product. In general, ID-25 packing logic proceeds in the following manner. A standard ERBE header is generated and written to the packed scene validation data product. Validation time and region information is processed and written to the ID-25, followed by packed scale factors and offsets. Finally, unpacked data records are sequentially processed and written to tape. The following steps describe in detail the scene validation data packing logic.

The generation of the ID-25 product begins with a call to INUTIL (#G.E.8.2.1) to initialize system utilities. NAMELIST file $NIPUO1, containing unit numbers and subsystem constants, is then read; refer to Table A-8i for the structure and contents of $NIPUO1. Next, scaling information is read from an input file of scale factors and offsets. ERBE header processing follows. Routine GETHED (#G.E.8.3.1) is invoked to retrieve the ID-4 logical header. A call to PPSPEC (#G.5.20) is then made to print out the ID-4 product specifications. Specifications include the following characteristics of the input data: temporal span, spacecraft name, product name, volume serial number associated with the ID-4 product, and the contents of the ERBE logical header. W16KEY (#G.E.8.3.5) is invoked to create a product key for the ID-25 and to write the corresponding physical header to tape.

Validation time and region information is processed next. NDIM21, the number of validation time intervals, and **VDTIM**, the validation time table array, are

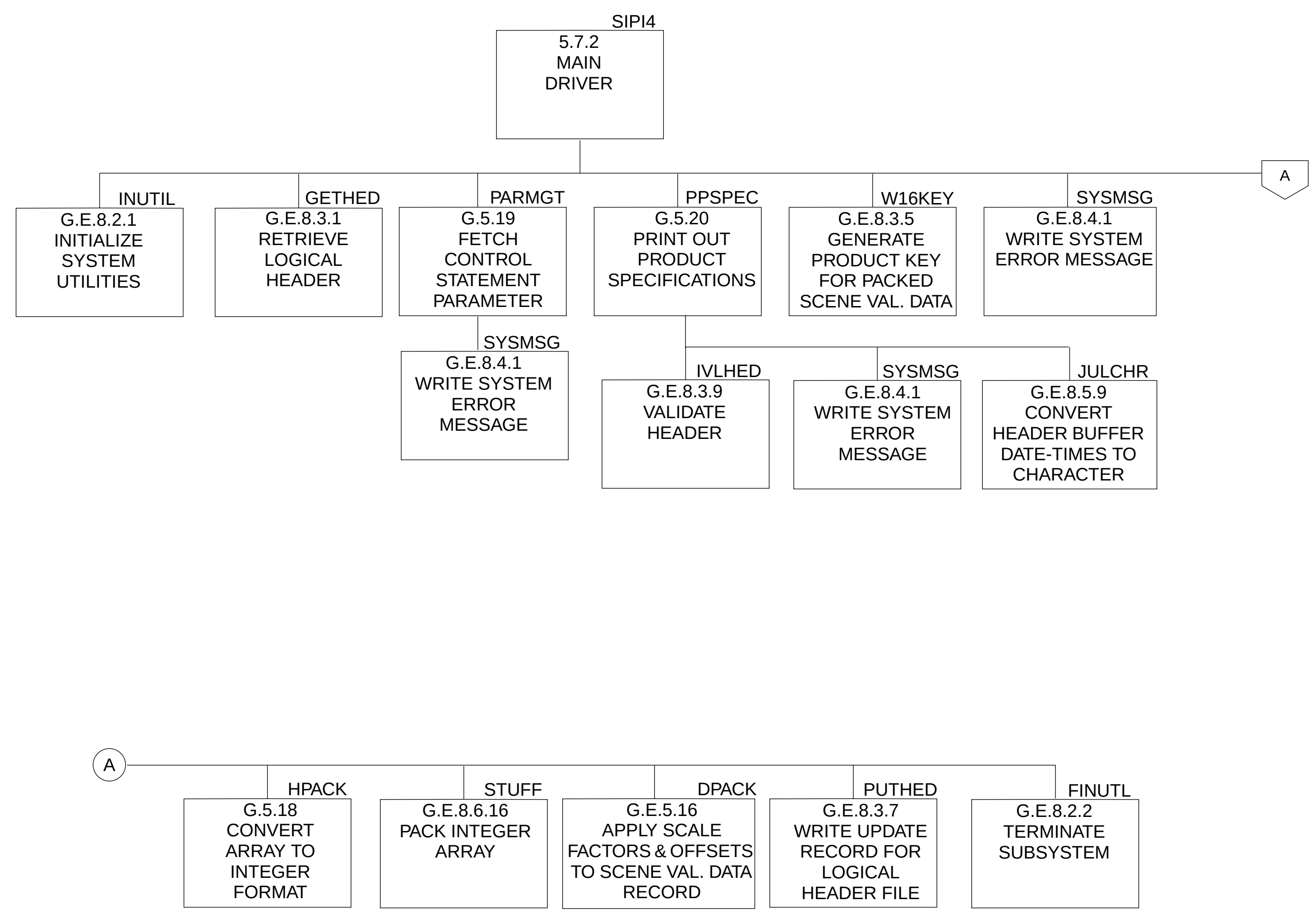


Figure 5.7-3. ID-4 Packing Program Funtional Structure Chart

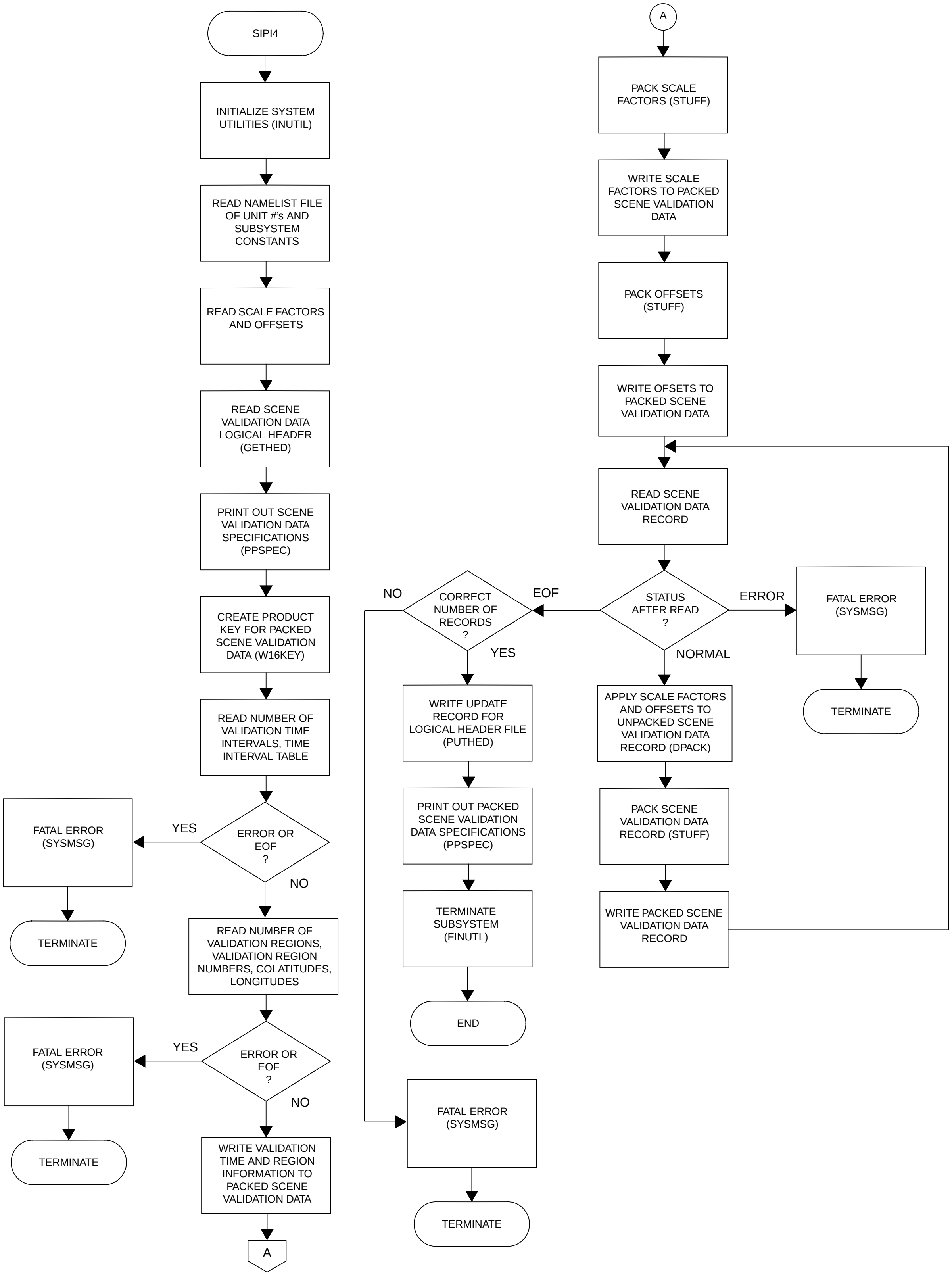


Figure 5.7-4. Flowchart of SIPI4 (Module 5.7.2)

read from the ID-4. NVPTS, the number of validation region numbers, is read, followed by the reading of arrays containing the validation region numbers (**NVREG**) and the validation region colatitudes (**VCOLAT**) and longitudes (**VLONG**). The validation time and region information is then written to the ID-25. Next, scaling information is processed.

The scale factor array is converted to integer format through a call to HPACK (#G.5.18). STUFF (#G.E.8.6.16) is then invoked to pack the scale factors; they are then written to the ID-25. Offset processing proceeds in a manner parallel to scale factor handling. HPACK is invoked to convert the offsets array to integer format, STUFF is invoked to pack the offsets, and the offsets are written to the ID-25.

Program SIPI4 then iteratively processes the unpacked data records in the following manner: seven words of region information and an unpacked PAT record are read from the ID-4. The seven words of region information are comprised of IVREG, an array of region numbers applicable to the current data record, NODE, an ascending/descending node flag, and TIME, the beginning time associated with the current record. DPACK (#G.5.16) is invoked to apply scale factors and offsets to the PAT record elements. A call to STUFF is then made to pack the data record into a 912 word array. The seven words of region information, followed by the PAT record, are then written to the ID-25.

Once all unpacked data records are processed, a call to PUTHED (#G.E.8.3.7) is made to write an update record for the logical header file for the ID-25 product. Routine PPSPEC is invoked to print out the ID-25 product specifications. FINUTL (#G.E.8.2.2) is then invoked to terminate processing.

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2. Design Guide to Orbital Flight, J. Jensen, G. Townsend, J. Kork, D. Kraft, McGraw-Hill Book Company, Inc., New York, 1962.

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EARTH RADIATION BUDGET EXPERIMENT

(ERBE)

DATA MANAGEMENT SYSTEM

REFERENCE MANUAL

VOLUME V(b)

Appendices, Section A through Section H

SECTION 5. INVERSION

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APPENDIX A

INVERSION SUBSYSTEM INPUT DATA

A.1 GENERAL

The primary input to the Inversion Subsystem includes radiometric, field-of-view (FOV), and ephemeris data provided by the Merge-FOV Subsystem (see Reference 1) in the form of a 24-hour unformatted unpacked data tape. This tape shall be referred to as the pre-PAT (see Section A.2 below). Other data required for Inversion Subsystem processing, and the programs in which these data are used, are shown in Tables A-1a and A-1b. These data are input in the form of either NAMELIST or binary files.

An off-line procedure driven software package provides access to various FORTRAN programs responsible for generating these input data. Each time a data file is generated using this software package, an Ancillary Input Data File summary is updated. This summary provides a history and the current status of all input data generated for the Inversion Subsystem.

A.2 PROCESSED ARCHIVAL TAPE (PAT)

The preliminary Processed Archival Tape (pre-PAT, ID-3) is a 24-hour unformatted unpacked data tape from the Merge-FOV Subsystem which is organized into records containing 16 seconds of scanner and nonscanner data. This pre-PAT is of the same format as the unpacked Processed Archival Tape (PAT60, ID-24), an Inversion Subsystem output product, except that it contains default values for data to be supplied by the Inversion Subsystem. The PAT60 provides a restart capability for the Inversion Subsystem, and, therefore, could itself become an Inversion input file. In the case of a restart, all data previously placed on the PAT60 by the Inversion Subsystem are replaced with newly calculated values or default values. This is to prevent previously calculated Inversion Subsystem values from being passed through to the new PAT60.

In this document, PAT* (ID-20) refers to an unpacked data file which is output from the Inversion Subsystem Main-Processor to the Post-Processor. PAT* does not contain inverted nonscanner data. The Inversion Subsystem archival product is the PAT (S-8). This packed data tape is generated off-line by

Table A-1a. Inversion System Input Files, excluding pre-PAT (1 of 2)

INPUT FILE NAME	DESCRIPTION	NO. OF VALUES
NAMGLB	NAMELIST file of ERBE System processing constants (see Reference 5).	9
IISCxx	Binary files (4), 2 for ERBS, 1 for NOAA 9, and 1 for NOAA 10, containing parameters for the spectral correction algorithm.	19489
IISWn	Binary file containing parameters for the scene identification algorithm that are temporally invariant.	13825
IILWss	Binary files (4) containing parameters for the scene identification algorithm that vary seasonally.	1920
ILGSym	Binary files containing character data for the scene identification algorithm that vary monthly.	72587
IIQWxx	Binary files (3), 1 for each satellite, containing quadrature weights for nonscanner data processing.	1193
NIPC02	NAMELIST file containing control and processing parameters for Main-Processor.	277
NIPP01	NAMELIST file containing control and processing parameters for Post-Processor and Monthly-Processor.	26
NIPU01	NAMELIST file containing control and processing parameters for data packing and dumping programs.	8
NIS2xx	NAMELIST files (3), 1 for each satellite, containing coefficients for the scene independent shape factor algorithm.	153
IISO02	Binary file containing scale factors and offsets used to pack or unpack PAT data records.	7260
IIMWSF	Binary file containing scale factors and offsets used to pack or unpack the Medium-Wide FOV Data Tape.	150
IIPTST	Binary file containing a demonstration PAT record which is placed on the second file of every S-8 product. This record is the second record from the Nov. 9, 1984 PAT.	

Table A-1a. Inversion System Input Files, excluding pre-PAT (2 of 2)

NOTES:

1. n is a version number; i.e. 01, 02, ..., 99.
2. xx is a spacecraft code.
   a. For quadrature weight and scene independent shape factor coefficient files:
      = NF, for NOAA 9
      = EB, for ERBS
      = NG, for NOAA 10
   b. For spectral correction algorithm parameter files:
      xx = NF, for NOAA 9
      E1, for ERBS data through Feb. 1985
      E2, for ERBS data from Mar. 1985
      NG, for NOAA 10
3. ss = WN, SP, SM, or AT for winter, spring, summer, or autumn, respectively.
4. y is a year code, i.e. 5 represents 1985.
5. m is a monthly code such that A through L represents Jan. through Dec.

Table A-1b. Inversion Subsystem Input File vs. Program Matrix

INPUT FILE	Program SIMAIN	SIPOST	SIMNTH	SIPI24	SIPI4	SIDS8	SIDI24	SIDI25
NAMGLB	✓	✓	✓	✓	✓	✓	✓	✓
IISCxx	✓							
IISWn IILWss IIGSym	✓							
IIQWxx	✓							
NIPC02	✓							
NIPP01		✓	✓					
NIPU01				✓	✓	✓	✓	✓
NIS2xx	✓							
IIS002				✓	✓			
IIMWSF		✓	✓					
IIPTST				✓				

program SIPI24 (see Section 5.7.1) as shown in Figure 5.0-1b. The content of the pre-PAT, PAT*, PAT60, and PAT is shown in Table A-2. The scale factor and offset columns shown in this table are nominal values used in the PAT packing and unpacking process.

Also, in this document, the pre-PAT and PAT60 (in the case of a restart) are referred to collectively as “input-PAT”.

For more extensive information regarding the PAT, see Reference 9.

Table A-2. Processed Archival Tape (ID-3, ID-20, ID-24, and S-8)

RESPONSIBLE[1] SUBSYSTEM A	B	C	RECORD INDEX	PARAMETER	UNITS	SCALE[2] FACTOR	OFFSET[2]	TIME INTERVAL (SEC)	NO. OF VALUES/ 16 SEC	NO. OF BITS/ VALUE	TOTAL BITS/ 16 SEC	CUMULATIVE TOTAL BITS
X			1	JULIAN DATE	day	1	0	16.	1	32	32	32
X			2	JULIAN TIME	day	10^9	0	16.	1	32	32	64
X			3	EARTH-SUN DISTANCE	Au	10^9	0	16.	1	32	32	96
X			4	S/C POSITION, x	m	1	0	16.	2	32	64	160
X			6	S/C POSITION, y	m	1	0	16.	2	32	64	224
X			8	S/C POSITION, z	m	1	0	16.	2	32	64	288
X			10	S/C VELOCITY, $\dot{x}$	m sec^{-1}	1	0	16.	2	32	64	352
X			12	S/C VELOCITY, $\dot{y}$	m sec^{-1}	1	0	16.	2	32	64	416
X			14	S/C VELOCITY, $\dot{z}$	m sec^{-1}	1	0	16.	2	32	64	480
X			16	S/C NADIR, COLATITUDE	deg	100	0	16.	2	16	32	512
X			18	S/C NADIR, LONGITUDE	deg	100	-180	16.	2	16	32	544
X			20	SUN POSITION, COLATITUDE	deg	100	0	16.	1	16	16	560
X			21	SUN POSITION, LONGITUDE	deg	100	-180	16.	1	16	16	576
X			22	ORBIT NUMBER	---	1	0	16.	1	16	16	592
X			23	SCANNER, FOV, COLATITUDE	deg	100	0	0.033	62x4	16	3968	4560
X			271	SCANNER, FOV, LONGITUDE	deg	100	-180	0.033	62x4	16	3968	8528
X			519	NONSCANNER, FOV, COLATITUDE	deg	100	0	0.8	20	16	320	8848
X			539	NONSCANNER, FOV, LONGITUDE	deg	100	-180	0.8	20	16	320	9168
X			559	SCANNER, RADIOMETRIC, TOTAL	wm^{-2}sr^{-1}	10	0	0.033	62x4	16	3968	13136
X			807	SCANNER, RADIOMETRIC, SW	wm^{-2}sr^{-1}	10	0	0.033	62x4	16	3968	17104
X			1055	SCANNER, RADIOMETRIC, LW	wm^{-2}sr^{-1}	10	0	0.033	62x4	16	3968	21072
X			1303	WFOV, RADIOMETRIC, TOTAL	wm^{-2}	10	0	0.8	20	16	320	21392
X			1323	WFOV, RADIOMETRIC, SW	wm^{-2}	10	0	0.8	20	16	320	21712
X			1343	MFOV, RADIOMETRIC, TOTAL	wm^{-2}	10	0	0.8	20	16	320	22032
X			1363	MFOV, RADIOMETRIC, SW	wm^{-2}	10	0	0.8	20	16	320	22352
X			1383	SCANNER, FOV, ZENITH, VIEWING	deg	100	0	0.033	62x4	16	3968	26320
X			1631	SCANNER, FOV, ZENITH, SUN	deg	100	0	0.033	62x4	16	3968	30228
X			1879	SCANNER, FOV, REL. AZIMUTH	deg	100	-180	0.033	62x4	16	3968	34256
X			2127	NONSCANNER, FOV, ZENITH, VIEWING	deg	100	0	16.	2	16	32	34288
X			2129	NONSCANNER, FOV, ZENITH, SUN	deg	100	0	16.	2	16	32	34320
X			2131	NONSCANNER, FOV, REL. AZIMUTH	deg	100	-180	16.	2	16	32	34352
			2133	SPARES	---	1	0	---	2	16	32	34348
X			2135	FLAG WORD, SCANNER OPERATIONS	---	1	0	16.	2	16	32	34416
X			2137	FLAG WORD, NONSCANNER OPERATIONS	---	1	0	16.	2	16	32	34448
X			2139	FLAG WORDS, SCANNER, RAD., TOT	---	1	0	0.033	18	16	288	34736
X			2157	FLAG WORDS, SCANNER, RAD., SW	---	1	0	0.033	18	16	288	35024
X			2175	FLAG WORDS, SCANNER, RAD., LW	---	1	0	0.033	18	16	288	35312
X			2193	FLAG WORDS, WFOV, RAD., TOT	---	1	0	0.8	2	16	32	35344
X			2195	FLAG WORDS, WFOV, RAD., SW	---	1	0	0.8	2	16	32	35376
X			2197	FLAG WORDS, MFOV, RAD., TOT	---	1	0	0.8	2	16	32	35408
X			2199	FLAG WORDS, MFOV, RAD., SW	---	1	0	0.8	2	16	32	35440
X			2201	FLAG WORDS, SCANNER, FOV	---	1	0	0.033	18	16	288	35728
X			2219	FLAG WORDS, NONSCANNER, FOV	---	1	0	0.8	2	16	32	35760
	X		2221	SCANNER, UNFILTERED, SW	wm^{-2}sr^{-1}	10	0	0.033	62x4	16	3968	39728
	X		2469	SCANNER, UNFILTERED, LW	wm^{-2}sr^{-1}	10	0	0.033	62x4	16	3968	43696
	X		2717	SCANNER, TOA EST., SW	wm^{-2}	10	0	0.033	62x4	16	3968	47644
	X		2965	SCANNER, TOA EST., LW	wm^{-2}	10	0	0.033	62x4	16	3968	51632
	X		3213	WFOV, UNFILTERED, SW	wm^{-2}	10	0	4.	4	16	64	51696
	X		3217	WFOV, UNFILTERED, LW	wm^{-2}	10	0	4.	4	16	64	51760
	X		3221	MFOV, UNFILTERED, SW	wm^{-2}	10	0	4.	4	16	64	51824
	X		3225	MFOV, UNFILTERED, LW	wm^{-2}	10	0	4.	4	16	64	51888
		X	3229	WFOV, TOA EST., NF, SW	wm^{-2}	10	0	32.	1	16	16	51904
		X	3230	WFOV, TOA EST., NF, LW	wm^{-2}	10	0	32.	1	16	16	51920
		X	3231	MFOV, TOA EST., NF, SW	wm^{-2}	10	0	32.	1	16	16	51936
		X	3232	MFOV, TOA EST., NF, LW	wm^{-2}	10	0	32.	1	16	16	51952
		X	3233	WFOV, TOA EST., SF, SW	wm^{-2}	10	0	32.	1	16	16	51968
		X	3234	WFOV, TOA EST., SF, LW	wm^{-2}	10	0	32.	1	16	16	51984
		X	3235	MFOV, TOA EST., SF, SW	wm^{-2}	10	0	32.	1	16	16	52000
		X	3236	MFOV, TOA EST., SF, LW	wm^{-2}	10	0	32.	1	16	16	52016
			3237	SPARES	---	1	0	---	4	16	64	52080
	X		3241	SCANNER, FOV, SCENE I.D.	---	10	0	0.033	62x4	8	1984	54064
		X	3489	FLAG, NONSCANNER, TOA EST.	---	1	0	16.	1	8	8	54072
			3490	SPARES	---	1	0	---	21	8	168	54240
X			3511	FLAG, NONSCANNER, WFOV	---	1	0	0.8	20	4	80	54320
X			3531	FLAG, NONSCANNER, MFOV	---	1	0	0.8	20	4	80	54400
			3551	SPARES	---	1	0	---	80	4	320	54720

NOTES:

1. The columns under RESPONSIBLE SUBSYSTEM show where in the ERBE processing stream that the various PAT elements are generated and onto which products as indicated below.
   A. Merge-FOV Subsystem generates the pre-PAT (ID-3).
   B. Inversion Subsystem Main-Processor generates the PAT* (ID-20).
   C. Inversion Subsystem Post-Processor generates the PAT60 (ID-24).
   D. Inversion Subsystem Off-Line Program SIPI24 (not shown) generates the PAT (S-8).
2. These are nominal values. The actual values used to scale the data are recorded in the third PAT file. See Section B.9 and Reference 9.

A.3 SPECTRAL CORRECTION COEFFICIENTS

The spectral correction algorithm calculates unfiltered measurement estimates according to

$$\hat{m}^{SW} = A^{SW} m_f^{SW} + B^{SW} m_f^{LW} + C^{SW} m_f^{TOT}$$

and

$$\hat{m}^{LW} = A^{LW} m_f^{SW} + B^{LW} m_f^{LW} + C^{LW} m_f^{TOT} \quad ,$$

where A^{SW}, B^{SW}, C^{SW}, A^{LW}, B^{LW}, and C^{LW} are the spectral correction coefficients and m_f^{SW}, m_f^{LW}, and m_f^{TOT} are the filtered measurements from the shortwave, longwave, and total scanner channels, respectively.

The spectral correction algorithm requires 19,200 daytime and 192 nighttime coefficients from which up to six must be selected to calculate the necessary unfiltered estimates. These coefficients are input through the arrays **SPCCDY** and **SPCCNT**. These and other input requirements of the spectral correction algorithm are shown in Table A-3.

THe spectral correction coefficients are spacecraft dependent. In addition, since the ERBS scanner instrument sustained sun damage in mid-February 1985, there are two files of spectral correction algorithm data for ERBS. One is for ERBS data through February 1985; the other is for ERBS data including March 1985 on.

For additional information on the spectral correction algorithm, see Section 5.2.2 and Reference 4.

Table A-3. Input Requirements of the Spectral Correction Algorithm

	ARRAY NAME	DIMENSION	DESCRIPTION	NO. OF VALUES
1.	SPCCDY	12 x 4 x 4 x 5 x 20	Daylight spectral correction coefficients	19,200
2.	SPCCNT	12 x 4 x 4	Nighttime spectral correction coefficients	192
3.	IGEOCN	5 x 0:2	Mapping from NGEO scene type to ISCN scene type	15
4.	INDXCD	6 x 6	Indexing array for daylight spectral correction coefficients	36
5.	INDXCN	5:6 x 3	Indexing array for nighttime spectral correction coefficients	6
6.	NITCAS	7	Indexing array for proper set of nighttime spectral correction coefficients	7
7.	CLDFRC	5	Fractional cloud covers associated with the five geo-scene types used to determine the "global" composite correction coefficients	5
8.	SCNFAC	4	Fractional cloud cover associated with the four cloud cover categories	4
9.	MSUN	1	Maximum number of solar zenith bins	1
10.	MZEN	1	Maximum number of spacecraft zenith bins	1
11.	MAZ	1	Maximum number of relative azimuth bins	1
12.	COEF	0:20	Temporary storage of spectral correction coefficients	21
NOTES: 1. These items are contained in COMMON Block /SPECOR/.				

A.4 SCENE IDENTIFICATION MATRICES

The purpose of the scene identification algorithm is to determine the cloud cover associated with a particular measurement and to combine this cloud cover with a predetermined geographic scene type. The combination of these two quantities defines the Inversion Subsystem scene type. The combination of these two quantities defines the Inversion Subsystem scene type. The 12 possible scene types are listed in Table A-4. In addition to these 12 values, a value of zero, indicating that the scene type was not determined, is also permissible on the PAT (see Sections 5.2 and 5.2.2.1).

Table A-4. Inversion Subsystem Scene Types

SCENE TYPE NO.	SCENE TYPE	
	GEO-SCENE	CLOUD COVER
1	Ocean	Clear
2	Land	Clear
3	Snow	Clear
4	Desert	Clear
5	Land-ocean mix	Clear
6	Ocean	Partly-cloudy
7	Land or desert	Partly-cloudy
8	Land-ocean mix	Partly-cloudy
9	Ocean	Mostly-cloudy
10	Land or desert	Mostly-cloudy
11	Land-ocean mix	Mostly-cloudy
12	Any	Overcast

The predetermined geographic scene types shown in the table are stored in the form of character data in the array **DYNID**. For example,

$$X = DYNID\ (IREG,\ JREG,\ 5)$$

is the geographic scene type for the 2.5-deg region with colatitudinal and longitudinal indices IREG and JREG, respectively, where X can take on values as shown in Table A-5.

Table A-5. Character Values Describing the Geographic Scene Type

X	GEOGRAPHIC SCENE TYPE
‘O’	Ocean
‘L’	Land
‘S’	Snow
‘D‘	Desert
‘C’	Coastal (land-ocean mix)

As shown in Table 5.2-16, the dynamic scene identification matrix, DYNID (IREG, JREG, 1-4), the nominal, clear sky, overhead sun albedo values, DYNID (IREG, JREG, 6), and the nominal, clear sky, longwave radiant exitance values, DYNID (IREG, JREG, 7), are also contained in **DYNID**. Though the dynamic scene identification matrix is continuously updated during Inversion Subsystem processing based on results from the scene identification algorithm, it is initialized with values produced by an off-line program.

Each element of the dynamic scene identification matrix is initialized to either ‘O’ or ‘H’ (see Table 5.2-17 in Section 5.2.6). This assignment is based on the global average cloud cover associated with the 2.5-deg region’s underlying geography. For example, if the cloud cover for the 2.5-deg region with indices IREG and JREG is determined to be partly cloudy, the elements for that region are defined as follows:

```
DYNID ( IREG, JREG, 1) = 'O' ,
DYNID ( IREG, JREG, 2) = 'H' ,
DYNID ( IREG, JREG, 3) = 'O' ,
```

and

```
DYNID ( IREG, JREG, 4) = 'O' .
```

This initialization is an important feature to overall Inversion Subsystem processing, since if scanner data is unavailable, the scene information provided by the initial values will be used to calculate nonscanner TOA estimates.

The character values contained in DYNID (IREG, JREG, 6 and 7) are evaluated according to a collating sequence as determined by a collation weight table (see Reference 10). Due to local operating system constraints, it is necessary to redefine the collation weight table during each Inversion Subsystem Main-Processor run. This is accomplished in the Main-Processor driver, INVERT (#5.0), as shown in Figure 5.0-4.

The **DYNID** array and other input data arrays required by the scene identification algorithm are shown in Tables A-6a and A-6b. Numerical values are contained in the COMMON Block /ID1/, and character data are contained in the COMMON Block /ID2/ as indicated in the table.

A complete set of the information as shown in Table A-6a is required for each run of the Main-Processor. The arrays are maintained on three "types" of files (see Table A-6c) depending on the temporal variation of the data. The Inversion Subsystem software selects the correct seasonal and monthly files based on the keyboard entry of the data during interactive job submission as described in Appendix H.

It should also be noted that the off-line software that generates the scene identification algorithm input files for the Inversion Subsystem generates a file of albedo directional models for the Monthly Time/Space Averaging Subsystem. This file is named ISDMn where n is the same version number as assigned to the IISWn file. When a new set of albedo directional models are incorporated into the Inversion Subsystem files, both IISWn and ISDMn are

Table A-6a. Description and Storage Location of Data Required for the Scene Identification Algorithm

			ARRAY INDICES									Associated Common Block	
ITEM NO.	DESCRIPTION	ARRAY NAME	NMODEL	KSUN	KZEN	KAZ	KCOLAT	KCOLAT’	KLONG	ITEM INDEX	NO. OF VALUES	/ID1/	/ID2/
1	SW bidirectional model	RMATRX	X	X	X	X				1	6720	X	
2	Standard deviation for each SW model value	RMATRX	X	X	X	X				2	6720	X	
3	Mean albedo for each of the SW models	ALBMN	X	X						1	120	X	
4	Albedo directional models	ALBMN	X	X						2	120	X	
5	Normalization constants for linearly interpolated SW bidirectional model values	ALBMN	X	X						3	120	X	
6	LW anisotropic model	AMATRX	X		X		X			1	840	X	
7	Standard deviation for each LW model value	AMATRX	X		X		X			2	840	X	
8	Mean LW radiant exitance	RELWMN	X				X			1	120	X	
9	Normalization constants for linearly interpolated LW anisotropic model	RELWMN	X				X			2	120	X	
10	Apriori probability statistics	AP	$NGEO_{max}(=5) \times NCC_{max}(=4)$				X				200	X	
11	Cloud cover/geo-scene to inversion scene type mapping	MODEL	$NCC_{max}(=4) \times NGEO_{max}(=5)$								20	X	
12	LW diurnal changes from overhead sun to midnight	DANTLW	$NGEO_{max}=5$								5	X	
13	Dynamic scene ID matrix for cloud cover categories	DYNID						X	X	1-4	41472		X
14	Static geographic scene type	DYNID						X	X	5	10368		X
15	Nominal, clear sky, overhead sun albedo	DYNID						X	X	6	10368		X
16	Nominal, clear sky, LW radiant exitance	DYNID						X	X	7	10368		X
17	Symbols for updating and retrieving elements of the scene ID matrix	IDYNID									11		X

Table A-6b. Description of Array Indices Shown in Table A-6a

ARRAY INDEX	D E S C R I P T I O N	MAXIMUM VALUE
NMODEL	Scene ID model no.	12
KSUN	Solar zenith bin no.	10
KZEN	Spacecraft zenith bin no.	7
KAZ	Relative azimuth bin no.	8
KCOLAT	Colatitudinal bin no.	10
KCOLAT'	Colatitudinal bin no.	72
KLONG	Longitudinal bin no.	144

Table A-6c. Description of the Scene Identification Algorithm Input Data Files

	TEMPORAL VARIATION		
	Constant	Seasonally	Monthly
File Name	IISWn	IILWss	IIGSym
Array Names	RMATRX ALBMN MODEL DANTLW	AMATRX RELWMN	DYNID IDYNID

NOTES:
1. n is a version number, ie. 01, 02, ..., 99.
2. ss represents WN, SP, SM, AT.
3. y is a yearly code, ie. y = 5 represents 1985.
4. m is a monthly code such that A through L represent Jan. through Dec.

routinely moved to the ERBE production account. This procedure ensures that the most recent albedo directional model value being used by the Inversion Subsystem are also available for production processing by the Monthly Time/ Space Averaging Subsystem.

A.5 QUADRATURE WEIGHTS

To solve the nonscanner inversion problem a grid system aligned with the spacecraft orbit (see Section 5.3.1.1) is superimposed over the FOV. This grid subdivides the FOV into smaller regions denoted by ij-regions with an associated area of FOV_{ij}. Figure A-1 shows this arrangement for the WFOV. In the figure, the groundtrack falls along the n-axis. The positive η direction is the direction of motion of the spacecraft.

Influence coefficients are required during nonscanner processing by both the shape factor and the numerical filter inversion algorithms. Calculation of these influence coefficients requires integrating over the FOV_{ij} of each of the ij-regions. This integration is given by

$$\gamma_{ij} = \frac{1}{\pi} \int_{FOV_{ij}} \cos\zeta \cos\theta'_s \left(\frac{r}{\rho}\right)^2 \cos\nu \; d\nu d\eta$$

where

> ζ is the nadir angle of the ij-region from the spacecraft,
> θ'_s is the spacecraft zenith angle,
> r is the radius to the TOA,
> ρ is the distance from the spacecraft to the ij-region,

and

> ν and η are the latitude and longitude of the ij-region in the groundtrack coordinate system as shown in Figure A-1.

Values of γ_{ij} are the precomputed quadrature weights. Since, due to bi-axial symmetry,

$$\gamma_{ij} = \gamma_{i,-j} = \gamma_{-i,j} = \gamma_{-i,-j} ,$$

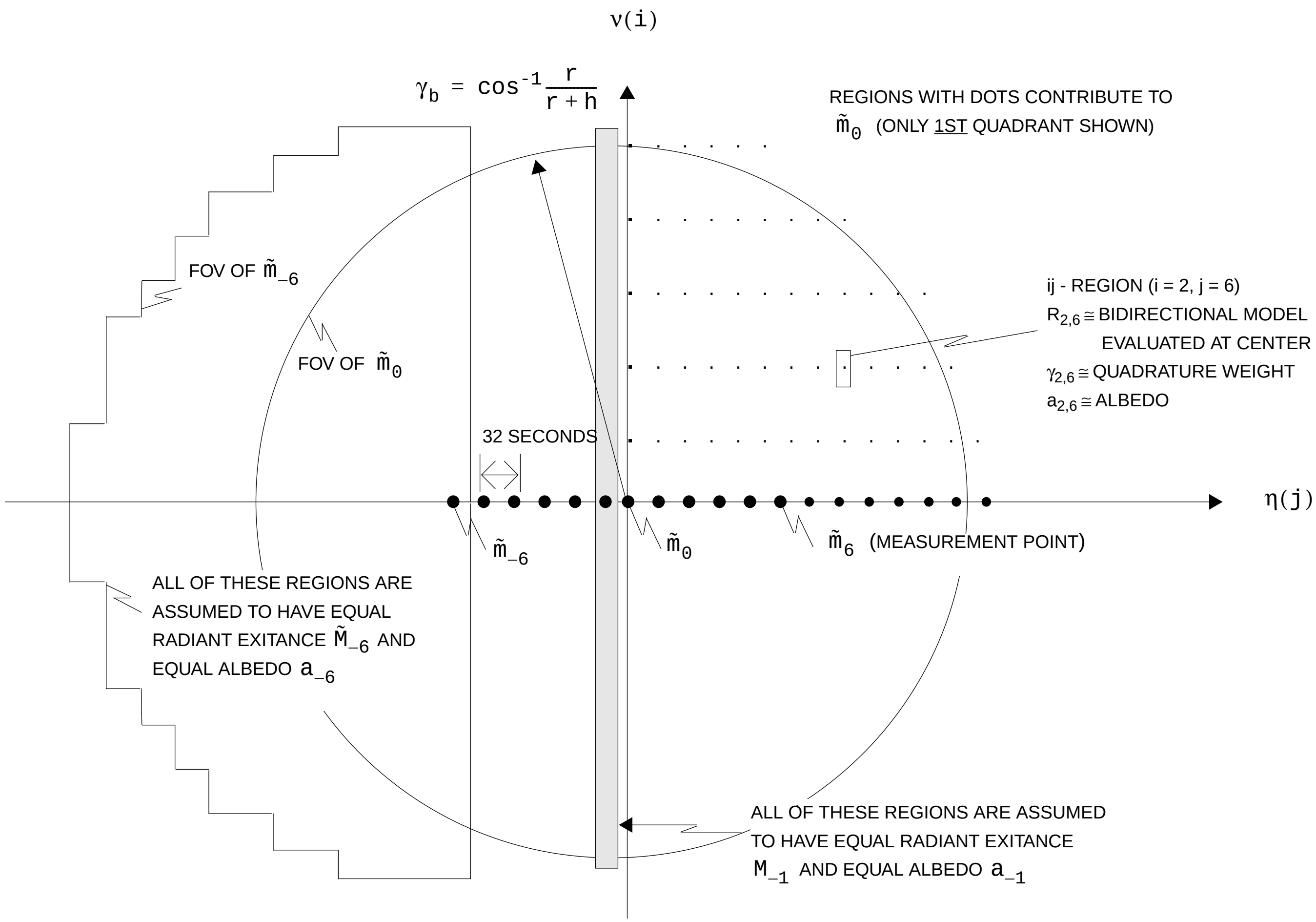


Figure A-1. Spacecraft Aligned Grid System only quadrature weights for one quadrant are input into the Inversion Subsystem. Two sets of these quadrature weights are required for each WFOV and MFOV data processing. The two sets correspond to quadrature weights at some maximum and minimum altitudes taking into consideration the possibility of an elliptical orbit. Intermediate values are computed as required during nonscanner processing by linear interpolation. In the case of a circular orbit, one set of quadrature weights will be calculated for each WFOV and MFOV during subsystem initialization. Since quadrature weights are spacecraft dependent, there are three sets of these values available for Inversion processing. The input file names are IIQWNF, IIQWEB, and IIQWNG. Table A-7 shows the information contained on these input files. In addition, the arrays QMFOV and QWFOV, which contain interpolated values, are shown.

The “Science Reference Manual”, Reference 4, contains a more detailed discussion of quadrature weights.

Table A-7. Data Contained on Input File and in COMMON Block /QUADWT/

PARAMETER	DIMENSION	D E S C R I P T I O N		NO. OF VALUES
QMMAX	0:13 X 0:13	MFOV quadrature weights at maximum altitude above the TOA	A	196
QMMIN	0:13 X 0:13	MFOV quadrature weights at minimum altitude above the TOA	A	196
QWMAX	0:13 X 0:13	WFOV quadrature weights at maximum altitude above the TOA	A	196
QWMIN	0:13 X 0:13	WFOV quadrature weights at minimum altitude above the TOA	A	196
QMFOV	0:13 X 0:13	MFOV interpolated quadrature weights	B	196
QWFOV	0:13 X 0:13	WFOV interpolated quadrature weights	B	196
HMAX	1	Maximum altitude above the TOA	A	1
HMIN	1	Minimum altitude above the TOA	A	1
SFMFOV	1	Constant shape factor for the MFOV, LW	A	1
ILIMIT	0:13	Number of regions in top or bottom half of strip, not counting center region	A	14

NOTES: 1. Under DESCRIPTION

A - indicates the parameter is contained on the IIQW(NF, EB, or NG) input file and in the /QUADWT/ COMMON Block.

B - indicates the parameter is calculated internally and is contained only in the /QUADWT/ COIMMON Block.

A.6 PROCESSING AND CONTROL PARAMETERS

Parameters used in Inversion Subsystem processing and to control the processing flow of the Inversion Subsystem are contained on three NAMELIST input files, NIPC01, NIPP01, and NIPU01. NIPC01 contains the NAMELISTs $NCONST, $NDIMEN, $NLIMIT, $NPATDA, $NPOINT, $NUNIT, and $NUSPAR. These NAMELISTs are used by the Main-Processor, described in Sections 5.0 - 5.4. Tables A-8a through A-8g show the contents of each of the NAMELISTs. NIPP01 contains the NAMELIST $NINVPP, the primary input for the Post-Processor and the Monthly-Processor, described in Sections 5.5 and 5.6. Table A-8h displays the contents of $NINVPP. The packing and dumping routines described in Section 5.7 and Appendix D use the NAMELIST file, $NIPU01. The contents of $NIPU01 are shown in Table A-8i.

These three NAMELIST files are all generated by the same off-line software. This ensures that when a parameter is contained on two or more of these files, it will have the same value on each file.

Table A-8a. NAMELIST $NCONST - Parameters remaining constant throughout execution of SIMAIN (1 of 2)

PARAMETER	DEFINITION	NOMINAL VALUES
SEC16	Time length of data time frame on PAT (sec).	16
SEC32	Period over which nonscanner radiometric data are averaged (sec).	32
N6	Degree of numerical filter.	6
NSFOV	Number of strips a WFOV measurement sees in the forward direction, not counting the center strip.	13
IPROD	Array (0:18) used to determine the value of NCASE, the parameter indicating scanner channel availability (see Figure 5.2-2 and Table 5.2-1 and Table 5.2-8).	
DELSUN	Factor used to calculate the solar zenith bin index, KSUN (see Table 5.2-11a).	9.999999
DELZEN	Factor used to calculate the zenith bin index, KZEN (see Table 5.2-11b).	3.000001
DELAZ	Factor used to calculate the azimuth bin index, KAZ (see Table 5.2-11c).	3.000001
DELCLT	Factor used to calculate the colatitudinal bin index, KCOLAT (see Table 5.2-11d).	18.000001
IZEN	Array (30) used to map from equally spaced zenith bins to unequally spaced zenith bins for the scene identification algorithm (see Table 5.2-11b).	
IAZ	Array (60) used to map from equally spaced azimuth bins to unequal spaced azimuth bins for the scene identification algorithm (see Table 5.2-11c).	
SPIN	Spin rate of earth (deg/sec).	0.004178
FACALB	Multiplicative factor for calculating the nominal, clear sky, overhead sun albedo from character data.	.0125
FACLW	Multiplicative factor for calculating the nominal, clear sky, LW radiant exitance from character data.	4.0

Table A-8a. NAMELIST $NCONST - Parameters remaining constant throughout execution of SIMAIN (2 of 2)

PARAMETER	DEFINITION	NOMINAL VALUES
ISPZEN	Array (6) used to map from equally spaced spacecraft zenith bins to unequally spaced spacecraft zenith bins with index LZEN (see Table 5.2-5) for the spectral correction algorithm.	
ISPAZ	Array (12) used to map from equally spaced azimuth bins to unequally spaced azimuth bins with index LAZ (see Table 5.2-7) for the spectral correction algorithm.	

Table A-8b. NAMELIST $NDIMEN - Array dimensions remaining constant throughout execution of SIMAIN (1 of 2)

PARAMETER	DEFINITION	NOMINAL VALUES
NDIM1	Number of rows in **XPATNS**.	100
NDIM2	Number of columns in **XPATNS** and number of elements in **XNSDAT**.	18
NDIM3	Number of elements in **XPAT**.	3630
NDIM4	Number of rows in **XACT25** and **IACT25**, or maximum number of regions that can be accumulated at one time.	150
NDIM5	Number of columns in **IACT25**.	15
NDIM6	Number of columns in **XACT25**.	19
NDIM7	Number of nadir regions (rows) in **XNAD5** and **INAD5**.	70
NDIM8	Number of elements in **XSCTSA**.	31
NDIM9	First dimension of **IHIST**, or maximum number of histograms that can be accumulated at one time.	10[1]
NDIM10	Second dimension of **IHIST**, or number of rows in histogram. This is the maximum number of albedo intervals per histogram.	13[1]
NDIM11	Third dimension of **IHIST**, or number of columns in histogram. This is the maximum number of longwave radiant exitance intervals per histogram.	13[1]
NDIM12	Number of Inversion Subsystem scene types.	12
NDIM13	Number of elements in **XNSTSA**.	62
NDIM14	Absolute value of upper and lower dimensions of **COSDEL** and **SINDEL** arrays. Must be equal to sum of the N6 and NSFOV parameters in Table A-8a.	19
NDIM15	Number of elements in **ISTAT**.	41
NDIM16	Number of elements in **XSTAT**.	2
NDIM17	Number of nadir regions (rows) in **XNAD10** and **INAD10**.	35

Table A-8b. NAMELIST $NDIMEN - Array dimensions remaining constant throughout execution of SIMAIN (2 of 2)

PARAMETER	DEFINITION	NOMINAL VALUES
NDIM18	Number of columns in **XNAD5** and **XNAD10.**	25
NDIM19	Number of elements in **ETVD.**	17
NDIM20	Dimension of the **NETVR** array. Also, the number of Earth Target Validation Regions.	4
NDIM21	Number of rows in the **VDTIM** array.	36
NDIM22	Number of columns in the **VDTIM** array.	4
NOTES: 1. These values are set to 1 since the Histogram Product is currently disabled.		

Table A-8c. NAMELIST $NLIMITS - Parameters limits remaining constant throughout execution of SIMAIN (1 of 2)

PARAMETER	DEFINITION	NOMINAL VALUES
SZLSID	Maximum solar zenith angle to be treated as daytime during scanner processing in the spectral correction algorithm and in the scene identification algorithm.	90.0
SZLTOA	Maximum solar zenith angle for which SW measurements are to be inverted (deg).	86.5
CDAYNT	Cosine of maximum solar zenith angle to be considered as daytime in the nonscanner inversion algorithms. When the cosine of the solar zenith angle is .GT. CDAYNT, it is daytime; otherwise, it is nighttime.	COS(SZLTOA)
HMAXZ	Maximum allowable spacecraft zenith angle for histograms (deg).	30.0
HMINA	Minimum of albedo range for histograms.	0.0
HMAXA	Maximum of albedo range for histograms.	1.0
HMINLW	Minimum of LW radiant exitance range for histograms (wm^{-2}).	100.0
HMAXLW	Maximum of LW radiant exitance range for histograms (wm^{-2}).	340.0
ALIM	Upper albedo limit for individual scanner estimates.	1.0
XMULIM	Upper radiant exitance limit for individual LW scanner (wm^{-2}).	400.0
AMAX	Maximum acceptable upper limit for LW anisotropic model value.	2.0
RMAX	Maximum acceptable upper limit for SW bidirectional model value.	2.0
ORBCK	Maximum acceptable difference between perigee altitude and apogee altitude for orbit to be treated as circular (meters).	30000.0
ZENMAX	Maximum acceptable value of spacecraft zenith angle for scanner data to be processed (deg).	70.0

Table A-8c. NAMELIST $NLIMITS - Parameters limits remaining constant throughout execution of SIMAIN (2 of 2)

PARAMETER	DEFINITION	NOMINAL VALUES
SIGMAX	Scanner measurement rejection limit on “SIGID”.	8.0
TIMLIM	Time limit used to determine whether “regions” are being seen after an N-orbit data drop (N = 1, 2, 3, ...) (days).	15./1440.[1]
DELMAX	Maximum acceptable upper limit for difference in the two unfiltered LW values in the 3 channel edit check (wm^{-2}).	10.0
SUNLIM	Maximum acceptable upper limit for daytime in determining SW offsets (degrees).	118.0
XMLLIM	Lower radiant exitance limit for individual LW scanner (wm^{-2}).	50.0
NOTES: 1. Legitimate values of TIMLIM can range from approximately 5 - 46 minutes. We have arbitrarily chosen 15 minutes or 15./1440 days [0.010417 days].		

Table A-8d. NAMELIST $NPATDA - Parameters associated with reading the input tape to SIMAIN

PARAMETER	DEFINITION	NOMINAL VALUES
JRECMN	Number of read attempts to make on input-PAT before turning on parity error processing.	0
JRECMX	Number of read attempts to make on input-PAT before turning off parity error processing.	5401
JMAXPE	Maximum number of parity errors allowed on input-PAT.	0
JMXPCT	Maximum allowable percentage of parity errors encountered on input-PAT to read attempts made.	0

Table A-8e. NAMELIST $NPOINT - Pointers to locations of elements on PAT
(1 of 3)

PARAMETER	DEFINITION	NOMINAL VALUES
NPSCLT	Pointer to location of colatitude of scanner target point.	23
NPSLNG	Pointer to location of longitude of scanner target point.	271
NPNCLT	Pointer to location of colatitude of center of non-scanner FOV.	519
NPNLNG	Pointer to location of longitude of center of non-scanner FOV.	539
NPSTOT	Pointer to location of scanner total channel data.	559
NPSSW	Pointer to location of scanner SW channel data.	807
NPSLW	Pointer to location of scanner LW channel data.	1055
NPWFT	Pointer to location of WFOV total channel data.	1303
NPWFS	Pointer to location of WFOV SW channel data.	1323
NPMFT	Pointer to location of MFOV total channel data.	1343
NPMFS	Pointer to location of MFOV SW channel data.	1363
NPZENS	Pointer to location of spacecraft zenith angle.	1383
NPZENO	Pointer to location of solar zenith angle.	1631
NPRAZ	Pointer to location of relative azimuth angle.	1879
NPSUSW	Pointer to location of scanner unfiltered SW data.	2221
NPSULW	Pointer to location of scanner unfiltered LW data.	2469
NPSTSW	Pointer to location of scanner SW TOA estimate.	2717
NPSTLW	Pointer to location of scanner LW TOA estimate.	2965

Table A-8e. NAMELIST $NPOINT - Pointers to locations of elements on PAT (2 of 3)

PARAMETER	DEFINITION	NOMINAL VALUES
NPWFUS	Pointer to location of WFOV SW unfiltered measurement.	3213
NPWFUL	Pointer to location of WFOV LW unfiltered measurement.	3217
NPMFUS	Pointer to location of MFOV SW unfiltered measurement.	3221
NPMFUL	Pointer to location of MFOV LW unfiltered measurement.	3225
NPNFTA	Pointer to location of numerical filter TOA estimates.	3229
NPSFTA	Pointer to location of shape factor TOA estimates.	3233
NPSCID	Pointer to location of scanner scene type.	3241
NPSOFW	Pointer to location of scanner operation flag word.	2135
NPFNSO	Pointer to location of nonscanner operations flag word.	2137
NPFSRT	Pointer to location of scanner, rad., TOT., flag words.	2139
NPFSRS	Pointer to location of scanner, rad., SW, flag words.	2157
NPFSRL	Pointer to location of scanner, rad., LW, flag words.	2175
NPFWRT	Pointer to location of WFOV, rad., TOT., flag words.	2193
NPFWRS	Pointer to location of WFOV, rad., SW, flag words.	2195
NPFMRT	Pointer to location of MFOV, rad., TOT., flag words.	2197
NPFMRS	Pointer to location of MFOV, rad., SW, flag words.	2199
NPFSCF	Pointer to location of scanner, FOV, flag words.	2201
NPFNSF	Pointer to location of nonscanner, FOV, flag words.	2219
NPFWFV	Pointer to location of nonscanner, WFOV flag.	3511
NPFMFV	Pointer to location of nonscanner, MFOV flag.	3531
NPDT5	Pointer to location of 5-deg (numerical filter) TOA estimates on the nonscanner to DDB output product.	5

Table A-8e. NAMELIST $NPOINT - Pointers to locations of elements on PAT
(3 of 3)

PARAMETER	DEFINITION	NOMINAL VALUES
NPDT10	Pointer to the location of 10-deg (shape factor) TOA estimates on the nonscanner to DDB output product.	34
NPNSTE	Pointer to the location of nonscanner, TOA estimate time/shape factor method flag.	3489
NPSFLG	Pointer to the location of the shape factor method used.	33

Table A-8f. NAMELIST $NUNIT - I/O unit numbers used by SIMAIN (1 of 2)

PARAMETER	DEFINITION	NOMINAL VALUES
IPAT	Unit number of pre-PAT data file from the Merge-FOV Subsystem or the PAT60 data file from the Inversion Subsystem.	22
IIDGS	Unit number of file containing scene identification data that varies monthly.	9
IQUADW	Unit number of file containing quadrature weights.	19
IGLOB	Unit number of file containing NAMELIST $NAMGLB.	1
ISPEC0	Unit number of file containing spectral correction coefficients.	2
ISHPFA	Unit number of file containing scene independent shape factor coefficients for method 2.	35
IIDLW	Unit number of file containing scene identification data that varies seasonally.	8
IIDSW	Unit number of file containing constant scene identification data.	7
IHOUT	Unit number for histogram output.	27[1]
ISCOUT	Unit number for scanner to DDB output.	25
INSOUT	Unit number for nonscanner to DDB output.	26
I24OUT	Unit number for PAT60 output.	75
IMWOUT	Unit number for daily MWDT output.	77
IETOUT	Unit number for ETVD output.	28
I12OUT	Unit number for PAT* output.	30
IPPOUT	Unit number for NAMELIST output to the Inversion Subsystem Post-Processor.	31
IVOUT	Unit number for Scanner and Nonscanner Scene Validation Data output product.	76

Table A-8f. NAMELIST $NUNIT - I/O unit numbers used by SIMAIN (2 of 2)

PARAMETER	DEFINITION	NOMINAL VALUES
IPSOUT	Unit number for Post-Processor Processing Summary output.	78
IMPOUT	Unit number for Main-Processor Processing Summary output.	29
IREQST	Unit number for the user product request file.	40
NOTES: 1. A value of 0 indicates that the product is turned off. The Histogram Product is currently disabled.		

Table A-8g. NAMELIST $NUSPAR - User adjustable parameters that remain constant during execution SIMAIN (1 of 2)

PARAMETER	DEFINITION	NOMINAL VALUES
KEYID3	Expected value of first 3 digits of the ERBE product key for pre-PAT.	402
KYID24	Expected value of first 3 digits of the ERBE product key for PAT60.	514
TPRD	Length of time over which nonscanner data is accumulated into the **XPATNS** storage array (minutes).	30
NOSEE	Number of consecutive data time frames that must be skipped before an active region of scanner data is closed.	2
N4	The selected 2.5-deg histogram regions are every N4th in colatitude and every N4th in longitude.	4
N9	The first 2.5-deg colatitude index number considered for histograms is the N9th.	9
N65	The last 2.5-deg colatitude index number considered for histograms is the N65th.	65
VTP	Validation time period for each validation point (minutes).	38.*16/60.
VCOLAT	Array (18) of colatitudinal values for scene validation data points.	
VLONG	Array (18) of longitudinal values for scene validation data points.	
NVREG	An array (18) of one-dimensional region numbers for 5-deg regions containing the scene validation data points.	
NVPTS	Number of scene validation data points.	18
NVDAY	Frequency for outputting scene validation data (days).	5
NETVR	Array (4) containing region numbers of Earth Target Validation Regions.	
XERROR	Default value for real variables.	2.**15-1

Table A-8g. NAMELIST $NUSPAR - User adjustable parameters that remain constant during execution SIMAIN (2 of 2)

PARAMETER	DEFINITION	NOMINAL VALUES
IERROR	Default value for integer variables.	2**15-1
NVDAYO	Offset for adjusting the NVDAY increments by a number of days.	0

Table A-8h. NAMELIST $NINVPP - Parameters associated with the **XMWDT** array (1 of 2)

PARAMETER	DEFINITION	NOMINAL VALUES
INFIL1	Unit number for input file containing NAMELIST $NPPOUT.	54
NWDS7	Number of elements in **XMWDT**.	75
MRECFR	Number of packed MWDT records in a MWDT data block.	20
MNWD	Array (4) containing the number of MWDT values to be packed at 32, 16, 8, or 4 bits/word.	
MFWA	Array (4) containing starting locations for elements of **XMWDT** to be packed at 32, 16, 8, or 4 bits/word.	
MNWD60	Number of 60-bit words resulting from packing **XMWDT**.	24
MWRADT	Pointer to location of WFOV, rad., total value.	23
MWRADS	Pointer to location of WFOV, rad., SW value.	27
MMRADT	Pointer to location of MFOV, rad., total value.	31
MMRADS	Pointer to location of MFOV, rad., SW value.	35
MWUNFS	Pointer to location of WFOV, unfiltered, SW value.	39
MWUNFL	Pointer to location of WFOV, unfiltered, LW value.	43
MMUNFS	Pointer to location of MFOV, unfiltered, SW value.	47
MMUNFL	Pointer to location of MFOV, unfiltered, LW value.	51
MWTOAN	Pointer to location of WFOV, TOA estimate, SW, numerical filter value.	55
MWTOAS	Pointer to location of WFOV, TOA estimate, SW, shape factor value.	59
MFOVLT	Pointer to location of nonscanner, FOV, colatitude value.	63
MFOVLG	Pointer to location of nonscanner, FOV, longitude value.	67

Table A-8h. NAMELIST $NINVPP - Parameters associated with the **XMWDT** array (2 of 2)

PARAMETER	DEFINITION	NOMINAL VALUES
MOPSWD	Pointer to location of nonscanner operations flag words.	71
ISFOFF	Unit number for input file containing the Medium-Wide scale factors and offsets.	60

Table A-8i. NAMELIST $NIPU01 - I/O unit numbers and parameters remaining constant throughout Packing and Dumping routines

PARAMETER	DEFINITION	NOMINAL VALUES
IID25	Unit number for packed Scanner and Nonscanner Scene Validation Data output product (ID-25).	102
IPATST	Unit number for input file containing the PAT test record.	112
IPAT60	Unit number for PAT60 input file.	75
IPSFOF	Unit number for scale factors and offsets to be applied to PAT data.	111
IS8	Unit number for PAT (S-8) output.	101
IVOUT	Unit number for Scanner and Nonscanner Scene Validation Data input product (ID-4).	76
NDIM3	Number of elements in **XPAT**.	3630
XERROR	Default value for real variables.	2.**15-1

A.7 SCENE INDEPENDENT SHAPE FACTOR COEFFICIENTS

In the event that there are insufficient data to determine TOA estimates by the scene dependent shape factor algorithm (see Nonscanner Data Processing, Section 5.3), subroutine NSINV requires that the special nonscanner processing mode be invoked using the scene independent shape factor algorithm. This algorithm is implemented in function SFAC2 (Section G.9.2) which calculates the required shape factor as shown in Figure G-15 using shape factor coefficients shown in Table A-9 and passed through the COMMON Block /SHPFAC/.

These coefficients are generated off-line and are provided to the on-line Inversion Subsystem software on file NIS2xx (see Table A-1a). This is a spacecraft dependent file so “xx” can be NF, EB, or NG for NOAA 9, ERBS, or NOAA 10, respectively.

There are actually three techniques for determining the shape factor value. The first is the scene dependent technique and is implemented during regular mode nonscanner processing in function SFAC1 (see Section G.9.1). One of the other two techniques are employed in function SFAC2 depending on the set of coefficients contained on the input file. The “2” in the file name above indicates that file contains coefficients for method 2. All three techniques are described in Reference 9.

Table A-9. Input Requirements for the Scene Independent Shape Factor Algorithm

PARAMETER	DIMENSION	DESCRIPTION	NO. OF VALUES
CLWMAX	2 x 2	LW coefficients at altitude, HMAX	4
CLWMIN	2 x 2	LW coefficients at altitude, HMIN	4
CSWMAX	3:4 x 2 x 18	SW coefficients at altitude, HMAX	72
CSWMIN	3:4 x 2 x 18	SW coefficients at altitude, HMIN	72
ISFFLG		Shape factor flag indicating which approach was implemented	1
PERID		Orbital period of spacecraft in seconds (this parameter is not used in SFAC2, but in VALDAT)	1
NOTES: 1. These items are contained in COMMON Block /SHPFAC/.			

A.8 SCALE FACTORS AND OFFSETS

Two sets of scale factors (SCF) and offsets (OFS) are used in packing and unpacking Inversion Subsystem data products. The packing equation is

$$PV = SCF\ (OV + OFS)$$

where PV is the packed value and OV is the original unpacked data value.

The binary input file ISFOFF contains a scale factor and offset for each element of the PAT (S-8) data record. IIMWSF is a subset of ISFOFF and contains a scale factor and offset for each element of the Medium-Wide FOV Data Tape (ID-12 and S-7) data record. The value of each PAT scale factor and offset is shown in Table A-2. THe value for each MWDT scale factor and offset is shown in Tables B-5a and B-5b. Table A-10 shows which values of ISFOFF are used to generate IIMWSF.

Table A-10. Mapping Between Medium-Wide FOV Data Tape and PAT Elements

Element No. on MWDT	Corresponding Element No. on PAT
1-22	1-22
23-62	1343-1382
63-66	519-522
67-70	539-542
71-75	----[1]
NOTES: 1. For these values scale factors are set to 1 and offsets are set to 0.	

APPENDIX B

INVERSION SUBSYSTEM OUTPUT

B.1 GENERAL

Table B-1 contains a list of Inversion Subsystem output products. All output products are optional and are controlled by “flags” as indicated in the table. These “flags” are contained in the /UNIT/ COMMON Block.

Unit numbers for the Inversion Subsystem output products are contained on $NUNIT from input file NIPC01. These unit numbers also serve as the product request ON/OFF flags; if the unit number is zero, the associated output product is not requested; if the unit number is non-zero (> 0), the output product is requested. In addition, output product requests are also specified as parameters to the procedure file, PINVSS, used to run the Inversion Subsystem Main-Processor and Post-Processor. These parameters define a file of product requests which are read and interpreted as ON/OFF flags in subroutine CHKREQ (#5.1.4). This technique makes it possible to control output product requests on a per job basis at job submission (see Appendix H).

It should be noted that for the ERBS spacecraft the ID-4 output product is automatically turned off by the software regardless of how the two ID-4 request flags are set.

B.2 SCANNER AND NONSCANNER SCENE VALIDATION DATA (ID-4/ID-25)

The Scanner and Nonscanner Scene Validation Data product (scene validation data, ID-4) is initially output from the Inversion Subsystem Post-Processor (see Section 5.5.2) as an unpacked product. It is then packed as described in Section 5.7.2. The packed product (ID-25) serves as an input to the Output Products Subsystem (V-5). Tables B-2a and B-2b show the content of these products.

Section 5.1.3 describes the Scene Validation Data Time Table used by the Post-Processor to generate the ID-4.

Table B-1. Inversion Subsystem Output Products (1 of 2)

INVERSION PRODUCT CODE	ERBE ID CODE	SOURCE[1]	FLAG[2]	COMMENTS
01	ID-6	1	ISCOUT	Scanner output to Daily Data Base Subsystem
02	ID-7	1	INSOUT	Nonscanner output to Daily Data Base Subsystem
03	ID-8	1	IHOUT	Histogram Product
04	ID-4	2	IVOUT	Scanner and Nonscanner Scene Validation Data
05	S-8	4	IS8	Processed Archival Tape (see Section A.2)
06	ID-12	2	IMWOUT	Daily Medium-Wide FOV Data Tape - Nonscanner
07	ID-13	1	IETOUT	Daily Earth Target Validation Data - Scanner
08	QC-7	1	IMPOUT	Inversion Subsystem Main-Processor Processing Summary
09	S-7	3	IS7OUT	Medium-Wide FOV Data Tape
10	V-6	3	IV6OUT	Earth Target Validation Data
11	QC-27	2	IPSOUT	Inversion Subsystem Post-Processor Processing Summary
12	ID-20	1	I12OUT	PAT* (see Section A.2)
13	ID-21	1	IPPOUT	Output Data to the Inversion Subsystem Post-Processor
14	ID-24	2	I24OUT	unpack Processed Archival Tape (see Section A.2)
15	ID-25	5	IID25	packed Scanner and Non-scanner Scene Validation Data
16	QC-44	3	IPS	Inversion Subsystem Monthly-Processor Processing Summary

Table B-1. Inversion Subsystem Output Products (2 of 2)

NOTES:

1. SOURCE shows where output is generated:
   1 indicates Inversion Subsystem Main-Processor (SIMAIN).
   2 indicates Inversion Subsystem Post-Processor (SIPOST).
   3 indicates Inversion Subsystem Monthly-Processor (SIMNTH).
   4 indicates Inversion Subsystem ID-24 packing program (SIPI24).
   5 indicates Inversion Subsystem ID-4 packing program (SIPI4).
2. FLAG is the name of the output control flag and of the local file containing the data. FLAG = 0 turns off output. These flags are input on the file NIPC01, NAMELIST $NUNIT.

Table B-2a. Scene Validation Data Output Product (ID-4)

RECORD NUMBER	C O N T E N T S	D E S C R I P T I O N
1	ERBE product key	See Reference 5.
2	NDIM21 (VDTIM(I,J), J=1, 4), I=1, NDIM21)	Number of validation time intervals (default = 36). Scene Validation Data Time Table, 4 words/time interval: Word 1 Region number. Word 2 Ascending/Descending node flag. Word 3 Start time (whole + fractional Julian date). Word 4 Stop time (whole + fractional Julian date).
3	NVPTS (NVREG(I), I=1, NVPTS) (VCOLAT(I), I=1, NVPTS) (VLONG(I), I=1, NVPTS)	Number of validation regions (default = 18). 5-deg validation region numbers. Colatitudes of validation points. Longitudes of validation points.
4 through end-of-file	(IVREG(I), I=1, 5) NODE TIME (XPAT(I), I=1, 3630)	Region numbers applicable to this data record (max = 5). Example: If this data record occurs during the time intervals for region numbers 47 and 49, then IVREG = 47, 49, 0, 0, 0. 0 for ascending node; 1 for descending node. Beginning time of record (whole + fractional Julian date). PAT60 data record.

Table B-2b. Packed Scene Validation Data Output Product (ID-25)

RECORD NUMBER	C O N T E N T S	D E S C R I P T I O N
1	ERBE product key	See Reference 5.
2	NDIM21 (VDTIM(I,J), J=1, 4), I=1, NDIM21)	Number of validation time intervals (default = 36). Scene Validation Data Time Table, 4 words/time interval: Word 1 Region number. Word 2 Ascending/Descending node flag. Word 3 Start time (whole + fractional Julian date). Word 4 Stop time (whole + fractional Julian date).
3	NVPTS (NVREG(I), I=1, NVPTS) (VCOLAT(I), I=1, NVPTS) (VLONG(I), I=1, NVPTS)	Number of validation regions (default = 18). 5-deg validation region numbers. Colatitudes of validation points. Longitudes of validation points.
4	(IPATSF(I), I = 1, 912)	PAT Scale factors in packed integers.
5	(IPATOF(I), I=1, 912)	PAT offsets in packed integers.
6 through end-of-file	(IVREG(I), I=1, 5) NODE TIME (IPPAT(I), I=1, 912)	Region numbers applicable to this data record (max = 5). Example: If this data record occurs during the time intervals for region numbers 47 and 49, then IVREG = 47, 49, 0, 0, 0. 0 for ascending node; 1 for descending node. Beginning time of record (whole + fractional Julian date). PAT60 data record.

B.3 SCANNER OUTPUT TO DAILY DATA BASE SUBSYSTEM (ID-6)

Table B-3 shows the content of each record on the regional scanner to DDB output file. The flow diagram of subroutine SCTSA in Section G.5.8 shows preset shortwave and longwave data default values (XERROR is contained in the /USPARM/ COMMON Block). Shortwave preset defaults are output when there are no shortwave data. If shortwave data are available for either daylight or nighttime, then XNSW, XMINSW, XMAXSW, and COSUN (items 6, 12, 13, and 23, respectively, in Table B-3) are calculated as shown in the flow diagram. If shortwave data exists only for nighttime, all other shortwave output parameters will contain their respective preset default values. Otherwise, shortwave data will be calculated as shown in the flow diagram.

Similarly, preset defaults are output when there are no longwave data. Otherwise, longwave data will be calculated as shown in the flow diagram.

Table B-3. Content of the **XSCTSA** Array Which Constitutes a Record on the Scanner Output to the Daily Data Base Subsystem (1 of 2)

ELEMENT NO.	SYMBOL	DESCRIPTION[1]	
1	XNREG	2.5-deg one-dimensional region number.	D
2	WJD	Average whole Julian date.	D
3	FJD	Average fractional Julian date.	D
4	AVGSW	Estimate of the average shortwave radiant exitance at the TOA (wm^{-2}).	B
5	AVGLW	Estimate of the average longwave radiant exitance at the TOA (wm^{-2}).	C
6	XNSW	Number of individual SW estimates.	A
7	STDSW	Standard deviation of individual SW estimates.	B
8	XMINSW	Minimum individual estimate of the shortwave radiant exitance at the TOA (wm^{-2}).	A
9	XMAXSW	Maximum individual estimate of the longwave radiant exitance at the TOA (wm^{-2}).	A
10	XNLW	Number of individual LW estimates.	C
11	STDLW	Standard deviation of individual LW estimates.	C
12	XMINLW	Minimum individual estimate of the longwave radiant exitance at the TOA (wm^{-2}).	C
13	XMAXLW	Maximum individual estimate of the longwave radiant exitance at the TOA (wm^{-2}).	C
14	XNGEO	Geographic scene type of 2.5-deg region (see Table 5.2-9).	D
15	FCR	Fraction of clear sky areas in 2.5-deg region.	B/D
16	FPC	Fraction of partly cloudy areas in 2.5-deg region.	B/D
17	FMC	Fraction of mostly cloudy areas in 2.5-deg region.	B/D

Table B-3. Content of the **XSCTSA** Array Which Constitutes a Record on the Scanner Output to the Daily Data Base Subsystem (2 of 2)

ELEMENT NO.	SYMBOL	DESCRIPTION[1]	
18	FOV	Fraction of overcast areas in 2.5-deg region.	B/D
19	ACR	Albedo of clear sky areas in 2.5-deg region.	B
20	APC	Albedo of partly cloudy areas in 2.5-deg region.	B
21	AMC	Albedo of mostly cloudy areas in 2.5-deg region.	B
22	AOV	Albedo of overcast areas in 2.5-deg region.	B
23	COSUN	Average of the individual cosines of the solar zenith angle at the target point for shortwave estimates.	A
24	SCZEN	Average of the individual spacecraft zenith angles from the target point for all estimates (degrees).	D
25	RELAZ	Average of the individual relative azimuth angles at the target point from the direction of forward solar scatter in the principal plane to the spacecraft direction for short-wave estimates (degrees).	B
26	STDACR	Standard deviation of individual shortwave albedos for areas identified as clear sky.	B
27	AVLWCR	Average of the individual longwave estimates of radiant exitance at the TOA for areas identified as clear sky (wm^{-2}).	C
28	STDLWC	Standard deviation of individual longwave estimates of the radiant exitance at the TOA for areas identified as clear sky.	C
29	XNLWCR	Number of individual longwave estimates for areas identified as clear sky.	C
30		Spare (=1.).	
31		Spare (=1.).	

NOTES: 1. Under DESCRIPTION, the last column denotes whether the value is a shortwave, longwave, or regional statistic.
A - Shortwave
B - Shortwave/Daytime
C - Longwave
D - Regional

B.4 NONSCANNER OUTPUT TO DAILY DATA BASE SUBSYSTEM (ID-7)

Nonscanner data are written to a local file for each available 32-sec nonscanner time interval. Each record on this file consists of the array **XNSTSA** which is shown in Table B-4. Section G.5.10 discusses the methods used to compute elements of the **XNSTSA** array.

The default value XERROR (XERROR is contained in the COMMON Block /USPARM/) when inserted for inverted nonscanner data indicates that no estimate of the radiant exitance at the TOA was calculated. Reasons for calculating no estimate are

- Insufficient data to invert the K^{th} measurement. If there is no nonscanner data available, the appropriate element of the **XMEAS** array is set to -1 in subroutine DATNS (#5.3.1.1). XMEAS (INS, K) = 0 is considered to be a good measurement.
  - Shape Factor Algorithm:

    if XMEAS (INS, K) < 0, do not invert
  - Numerical Filter Algorithm:

    if XMEAS (INS, I) < 0, for $K - N6 \leq I \leq K + N6$, do not invert the K^{th} measurement.
- Insufficient daylight in the case of the K^{th} shortwave measurement.
  - Shape Factor Algorithm:

    if CSUN00 (K)$\leq$ CDAYNT, do not invert the K^{th} measurement
  - Numerical Filter Algorithm:

    if CSUN00 (K)$\leq$ CDAYNT, for $K - N6 \leq I \leq K + N6$, do not invert the K^{th} measurement.

Sections 5.3.1.3 and G.9 contain additional details concerning nonscanner data inversion by the numerical filter and shape factor algorithms. The variables XMEAS and CSUN00 are described in Table F-27. N6 is in the COMMON Block /CONST/, and CDAYNT is in COMMON Block /LIMITS/.

Table B-4. Content of the **XNSTSA** Array Which Constitutes a Record on the Nonscanner Output to the Daily Data Base Subsystem (1 of 4)

ELEMENT NO.	SYMBOL	DESCRIPTION
1	NREG5	5-deg one-dimensional region number.
2	NREG10	10-deg one-dimensional region number.
3	WJD	Whole Julian date at the center of 32-sec nonscanner time interval.
4	FJD	Fractional Julian date at the center of 32-sec nonscanner time interval.
5	ADJ7	Numerical filter estimate of the SW radiant exitance at the TOA for MFOV adjusted to the center of the 5-deg nadir region (wm^{-2}).
6	ESTNS(5)	Numerical filter estimate of the LW radiant exitance at the TOA for MFOV over the 5-deg nadir region (wm^{-2}).
7	ADJ8	Numerical filter estimate of the SW radiant exitance at the TOA for WFOV adjusted to the center of the 5-deg nadir region (wm^{-2}).
8	ESTNS(6)	Numerical filter estimate of he LW radiant exitance at the TOA for WFOV over the 5-deg nadir region (wm^{-2}).
9	CSUN5	Cosine of the solar zenith angle at the center of the 5-deg nadir region. If CSUN5 < 0, set CSUN5 = 0.
10	ZENS5	Spacecraft zenith angle from the center of the 5-deg nadir region (degrees).
11	AZSC5	Relative azimuth angle at center of 5-deg nadir region from the direction of forward solar scatter in the principal plane to the spacecraft direction. Let AZSC5 = 0, when CSUN5 = 0 (degrees).
12	FM5(1)	Shortwave area scene fraction of ocean for the 5-deg nadir region.
13	FM5(2)	Fraction of land.
14	FM5(3)	Fraction of snow.

Table B-4. Content of the **XNSTSA** Array Which Constitutes a Record on the Nonscanner Output to the Daily Data Base Subsystem (2 of 4)

ELEMENT NO.	SYMBOL	D E S C R I P T I O N
15	FM5(4)	Fraction of desert.
16	FM5(5)	Fraction of partly cloudy over ocean.
17	FM5(6)	Fraction of partly cloudy over land or desert.
18	FM5(7)	Fraction of mostly cloudy over ocean.
19	FM5(8)	Fraction of mostly cloudy over land or desert.
20	FM5(9)	Fraction of overcast.
21	AM5(1)	Normalized scene albedo over ocean for the 5-deg nadir region.
22	AM5(2)	Normalized scene albedo over land.
23	AM5(3)	Normalized scene albedo over snow.
24	AM5(4)	Normalized scene albedo over desert.
25	AM5(5)	Normalized scene albedo for partly cloudy over ocean.
26	AM5(6)	Normalized scene albedo for partly cloudy over land or desert.
27	AM5(7)	Normalized scene albedo for mostly cloudy over ocean.
28	AM5(8)	Normalized scene albedo for mostly cloudy over land or desert.
29	AM5(9)	Normalized scene albedo for overcast.
30	FLAN5	Geo-land (land and desert) fraction for 5-deg nadir region.
31	ESTNS(8)	Numerical filter estimate of the SW radiant exitance at the TOA for WFOV over the 5-deg nadir region (wm^{-2}).
32	ESTNS(7)	Numerical filter estimate of the SW radiant exitance at the TOA for MFOV over the 5-deg nadir region (wm^{-2}).
33	ISF	Shape factor method flag to be added to the nonscanner, TOA estimate time/shape factor method flag on PAT in the Post-Processor.

Table B-4. Content of the **XNSTSA** Array Which Constitutes a Record on the Nonscanner Output to the Daily Data Base Subsystem (3 of 4)

ELEMENT NO.	SYMBOL	D E S C R I P T I O N
34	ADJ3	Shape factor estimate of the SW radiant exitance at the TOA for MFOV adjusted to the center of the 10-deg nadir region (wm^{-2}).
35	ESTNS(1)	Shape factor estimate of the LW radiant exitance at the TOA for MFOV over the 10-deg nadir region (wm^{-2}).
36	ADJ4	Shape factor estimate of the SW radiant exitance at the TOA for WFOV adjusted to the center of the 10-deg nadir region (wm^{-2}).
37	ESTNS(2)	Shape factor estimate of the LW radiant exitance at the TOA for WFOV over the 10-deg nadir region (wm^{-2}).
38	CSUN10	Cosine of the solar zenith angle at the center of the 10-deg nadir region. If CSUN10 < 0, set CSUN10 = 0.
39	ZENS10	Spacecraft zenith angle from the center of the 10-deg nadir region (degrees).
40	AZSC10	Relative azimuth angle at center of 10-deg nadir region from the direction of forward solar scatter in the principal plane to the spacecraft direction. Let AZSC10 = 0, when CSUN10 = 0 (degrees).
41	FM10(1)	Shortwave area scene fraction of ocean for the 10-deg nadir region.
42	FM10(2)	Fraction of land.
43	FM10(3)	Fraction of snow.
44	FM10(4)	Fraction of desert.
45	FM10(5)	Fraction of partly cloudy over ocean.
46	FM10(6)	Fraction of partly cloudy over land or desert.
47	FM10(7)	Fraction of mostly cloudy over ocean.
48	FM10(8)	Fraction of mostly cloudy over land or desert.
49	FM10(9)	Fraction of overcast.

Table B-4. Content of the **XNSTSA** Array Which Constitutes a Record on the Nonscanner Output to the Daily Data Base Subsystem (4 of 4)

ELEMENT NO.	SYMBOL	D E S C R I P T I O N
50	AM10(1)	Normalized scene albedo over ocean for the 10-deg nadir region.
51	AM10(2)	Normalized scene albedo over land.
52	AM10(3)	Normalized scene albedo over snow.
53	AM10(4)	Normalized scene albedo over desert.
54	AM10(5)	Normalized scene albedo for partly cloudy over ocean.
55	AM10(6)	Normalized scene albedo for partly cloudy over land or desert.
56	AM10(7)	Normalized scene albedo for mostly cloudy over ocean.
57	AM10(8)	Normalized scene albedo for mostly cloudy over land or desert.
58	AM10(9)	Normalized scene albedo for overcast.
59	FLAN10	Geo-land (land and desert) fraction for 10-deg nadir region.
60	ESTNS(4)	Shape factor estimate of the SW radiant exitance at the TOA for WFOV over the 10-deg nadir region (wm^{-2}).
61	ESTNS(3)	Shape factor estimate of the SW radiant exitance at the TOA for MFOV over the 10-deg nadir region (wm^{-2}).
62		Spare (=1.).

B.5 HISTOGRAM PRODUCT (ID-8)

The dimensions of each individual histogram follow the physical header record on the Histogram Product (ID-8) and are written as shown below:

```
WRITE (IHOUT) NDIM10, NDIM11.
```

NDIM10 and NDIM11 are contained in the COMMON Block /DIMEN/.

Subsequent histogram data output records are produced in subroutine HISTO (#G.5.4) according to

```
WRITE (IHOUT) NREG, WJD, FJD, LHOUR,
              ((IHIST (IPOINT, I, J), J = 1, NDIM11), I = 1, NDIM10)
```

where

NREG is the 2.5-deg one-dimensional region number,
WJD is the average whole Julian data for this region from XSCTSA(2),
FJD is the average fractional Julian date for this region from XSCTSA(3),

and

LHOUR is the local hour index associated with region NREG at Julian time FJD.

The **XSCTSA** array is defined in Table B-3.

The array **IHIST** contains histogram data for the NREGth region. IPOINT is an index into **IHIST** for the region NREG. Recall from Table 5.2-14 that

```
NREG = IACT25(K, 1)
```

and

```
IPOINT = IACT25(K, 11) .
```

Each histogram as illustrated below in Figure B-1 is for the 2.5-deg region, NREG, and the local hour index, LHOUR.

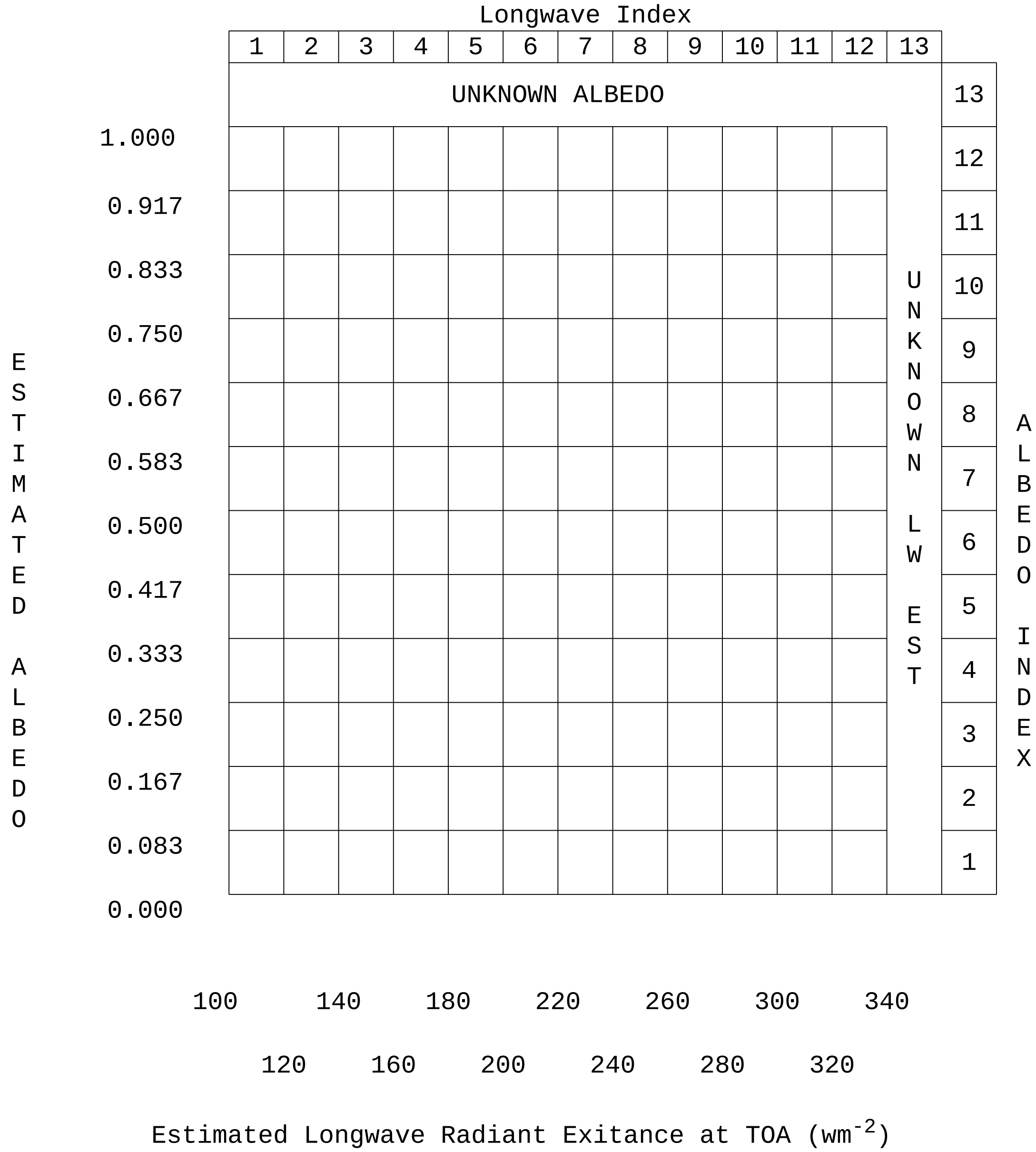


Figure B-1. Illustration of Histogram

B.6 MEDIUM-WIDE FOV DATA TAPE (ID-12/S-7)

The daily Medium-Wide FOV Data Tape (daily MWDT, ID-12) is generated by the Inversion Subsystem Post-Processor (see Section 5.5.2). The daily products serve as input to the Monthly-Processor which generates the Medium-Wide FOV Data Tape (MWDT, S-7) as described in Section 5.6. The content of each MWDT data record is shown in Table B-5a. The file structure for the MWDT is shown in Table B-5b. Each monthly tape contains data from only one satellite.

Also, refer to the Monthly MWDT Users' Guide (Reference 7).

Table B-5a. Medium-Wide FOV Data Tape Record (1 of 2)

ITEM NO.	DESCRIPTION	UNITS	SCALE FACTOR	OFFSET	NO. OF VALUES PER 16 SEC	BITS PER VALUE	BITS PER 16 SEC
1	Julian date	day	1	0	1	32	32
2	Julian time	day	10^9	0	1	32	32
3	Earth-sun distance	AU	10^9	0	1	32	32
4-5	Spacecraft position, x	m	1	0	2	32	64
6-7	Spacecraft position, y	m	1	0	2	32	64
8-9	Spacecraft position, z	m	1	0	2	32	64
10-11	Spacecraft velocity, $\dot{x}$	m sec^{-1}	1	0	2	32	64
12-13	Spacecraft velocity, $\dot{y}$	m sec^{-1}	1	0	2	32	64
14-15	Spacecraft velocity, $\dot{z}$	m sec^{-1}	1	0	2	32	64
16-17	Spacecraft nadir position, colatitude	deg	100	0	2	16	32
18-19	Spacecraft nadir position, longitude	deg	100	-180	2	16	32
20	Sun position, colatitude	deg	100	0	1	16	16
21	Sun position, longitude	deg	100	-180	1	16	16
22	Orbit number	---	1	0	1	16	16
23-26	WFOV, radiometric data, total	wm^{-2}	10	0	4	16	16
27-30	WFOV, radiometric data, shortwave	wm^{-2}	10	0	4	16	64
31-34	MFOV, radiometric data, total	wm^{-2}	10	0	4	16	64
35-38	MFOV, radiometric data, shortwave	wm^{-2}	10	0	4	16	64

Table B-5a. Medium-Wide FOV Data Tape Record (2 of 2)

ITEM NO.	DESCRIPTION	UNITS	SCALE FACTOR	OFFSET	NO. OF VALUES PER 16 SEC	BITS PER VALUE	BITS PER 16 SEC
39*-42	WFOV, unfiltered, SW	wm^{-2}	10	0	4	16	64
43-46	WFOV, unfiltered, LW	wm^{-2}	10	0	4	16	64
47-50	MFOV, unfiltered, SW	wm^{-2}	10	0	4	16	64
51-54	MFOV, unfiltered, LW	wm^{-2}	10	0	4	16	64
55	WFOV, TOA est., NF, SW[1]	wm^{-2}	10	0	1	16	16
56	WFOV, TOA est., NF, LW[1]	wm^{-2}	10	0	1	16	16
57	MFOV, TOA est., NF, SW[1]	wm^{-2}	10	0	1	16	16
58	MFOV, TOA est., NF, LW[1]	wm^{-2}	10	0	1	16	16
59	WFOV, TOA est., SF, SW[1]	wm^{-2}	10	0	1	16	16
60	WFOV, TOA est., SF, LW[1]	wm^{-2}	10	0	1	16	16
61	MFOV, TOA est., SF, SW[1]	wm^{-2}	10	0	1	16	16
62	MFOV, TOA est., SF, LW[1]	wm^{-2}	10	0	1	16	16
63-66	Nonscanner, FOV, colatitude	deg	100	0	4	16	64
67-70	Nonscanner, FOV, longitude	deg	100	-180	4	16	64
71-72	Nonscanner operating mode flag word	---	1	0	2	16	32
	Subtotal						1392
73-75	Spares				3	16	48
	Total bits/16-sec record						1440

NOTES: 1. TOA estimates are taken to be at the center of the 32-sec nonscanner average measurement interval.

Table B-5b. Medium-Wide FOV Data Tape File Structure

File Number (I)	Contents
1	ERBE product key.
2	Packed scale factor record. Packed offset record. 1-270 blocks of data for 1st day of available data.
3 through end-of- information	1-270 blocks of data for (I-1)th of available data.

B.7 EARTH TARGET VALIDATION DATA (ID-13/V-6)

Table B-6a shows the content of the Earth Target Validation Data (ETVD, ID-13/V-6) output record. Whenever an Earth Target Validation 2.5-deg region is encountered during individual scanner data processing, these data are output for that region through the **ETVD** array onto a local file with unit number IETOUT (see Section 5.2.3).

Subsequently, the Inversion Subsystem Monthly-Processor combines IETOUT (ID-13) with other daily data files on the monthly data tape (V-6) as described in Section 5.6. Each monthly tape contains data from only one satellite.

Table B-6b shows the structure of the ETVD tape. Also, refer to the Monthly ETVD Users' Guide (Reference 8).

Table B-6a. Content of **ETVD** Array

J	ETVD(J)[1]	SYMBOL	DESCRIPTION	UNITS
1	Formal parameter in argument list	NREG	2.5-deg one-dimensional region number	----
2	I + NPSCID[2]	NMODEL	Scene type	----
3	1	WJD	Whole Julian day	day
4	2	FJD	Fractional Julian day	day
5	EO/(XPAT(3) * XPAT(3))	SOLCON	Corrected solar constant	wm^{-2}
6	22		Orbit number	----
7	I + NPSTOT[2]	XFMTOT	Total channel measurement	$wm^{-2}sr^{-1}$
8	I + NPSSW[2]	XFMSW	Shortwave channel measurement	$wm^{-2}sr^{-1}$
9	I + NPSLW[2]	XFMLW	Longwave channel measurement	$wm^{-2}sr^{-1}$
10	I + NPSUSW[2]	XMSW	Unfiltered shortwave measurement	$wm^{-2}sr^{-1}$
11	I + NPSULW[2]	XMLW	Unfiltered longwave measurement	$wm^{-2}sr^{-1}$
12	I + NPSCLT[2]	COLAT	Colatitude of the measurement point	deg
13	I + NPSLNG[2]	XLONG	Longitude of the measurement point	deg
14	I + NPZENS[2]	ZENSTP	Spacecraft zenith angle	deg
15	I + NPZEN0[2]	ZENOTP	Solar zenith angle	deg
16	I + NPRAZ[2]	AZSOTP	Relative azimuth angle	deg
17	NPSOFW[2]		Scanner operating mode	----

NOTES:
1. Under ETVD(J) are listed element numbers from the **XPAT** array unless otherwise noted. The index I ranges from 0 to 247 per 16-sec record.
2. These “pointers” are contained in the /POINT/ COMMON Block and defined in Table A-8e.

Table B-6b. Earth Target Validation Data File Structure

File Number (I)	Contents
1	ERBE product key. Records of Earth Target Validation Data for 1st day of available data.
2 through end-of-information	Records of Earth Target Validation Data for I^{th} day of available data.

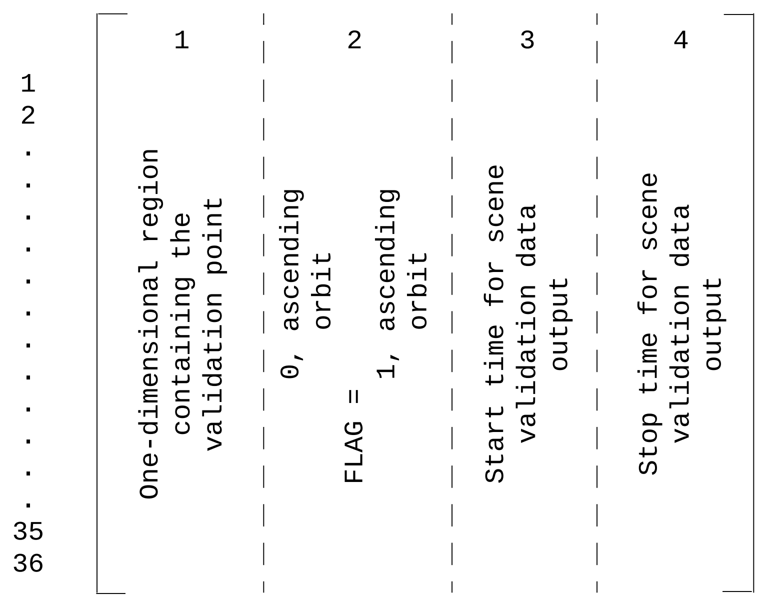
B.8 OUTPUT DATA TO THE INVERSION SUBSYSTEM POST-PROCESSOR (ID-21)

Data required by the Inversion Subsystem Post-Processor (see Section 5.5) are written on local file IPPOUT as two NAMELIST records. The content of NAMELIST $NPPOUT is shown in Table B-7. These data are input to the Main-Processor from file NIPC01 (see Section A.6) and are output from subroutine STRT5 (#5.1) by

WRITE (IPPOUT, NPPOUT).

NAMELIST $NVTOUT contains the array **VDTIM** (see subroutine VALDAT, #5.1.3) illustrated below.

VDTIM =



This NAMELIST record is written from subroutine VALDATA as

WRITE (IPPOUT, NVTOUT).

Table B-7. NAMELIST Output from the Inversion Subsystem Main-Processor to the Inversion Subsystem Post-Processor

$NVTOUT	
VDTIM (NDIM21,NDIM22)	Scene Validation Data Time Table.
$NPPOUT	
INSOUT	Unit number for nonscanner to DDB (ID-7).
IVOUT	Unit number for scene validation data (ID-4).
I24OUT	Unit number for PAT60 (ID-24).
IMWOUT	Unit number for daily MWDT (ID-12).
IPSOUT	Unit number for Post-Processor Processing Summary (QC-27).
I12OUT	Unit number for PAT* (ID-20).
XERROR	Default data value.
NDIM21	Number of validation time intervals (default = 36).
NVPTS	Number of validation regions (default = 18).
NVREG (NVPTS)	Validation region numbers.
VCOLAT (NVPTS)	Colatitudes of validation points (degrees).
VLONG (NVPTS)	Longitudes of validation points (degrees).
NDIM22	Number of columns in **VDTIM** array (4).
NDIM13	Number of words in a nonscanner to DDB record (ID-7).
NPDT5	Pointer to location of 5-deg TOA est. on nonscanner to DDB.
NPDT10	Pointer to location of 10-deg TOA est. on nonscanner to DDB.
NPNFTA	Pointer to location of 5-deg TOA est. on PAT* (NF).
NPSFTA	Pointer to location of 10-deg TOA est. on PAT* (SF).
NPWFT	Pointer to location of WFOV, rad., TOT., on PAT*.
NPWFS	Pointer to location of WFOV, rad., SW., on PAT*.
NPMFT	Pointer to location of MFOV, rad., TOT., on PAT*.
NPMFS	Pointer to location of MFOV, rad., SW., on PAT*.
NPWFUS	Pointer to location of WFOV, unfiltered, SW on PAT*.
NPWFUL	Pointer to location of WFOV, unfiltered, LW on PAT*.
NPMFUS	Pointer to location of MFOV, unfiltered, SW on PAT*.
NPMFUL	Pointer to location of MFOV, unfiltered, LW on PAT*.
NDIM3	Number of elements in a PAT60 data record (3630).
NPNCLT	Pointer to location of colatitude of center of nonscanner FOV on PAT*.
NPNLNG	Pointer to location of longitude of center of nonscanner FOV on PAT*.
NPFNSO	Pointer to location of flag words, nonscanner record level flag in the XPAT data record.
NPNSTE	Pointer to location of nonscanner TOA estimate Time/Shape Factor method flag in the XPAT data record.
NPSFLG	Pointer to location of shape factor method flag in the nonscanner data record.

B.9 UNPACKED PROCESSED ARCHIVAL TAPE (ID-24)/PROCESSED ARCHIVAL TAPE (S-8)

The unpacked Processed Archival Tape (PAT60, ID-24) is generated by the Inversion Subsystem Post-Processor (see Section 5.5.2). The Processed Archival Tape (PAT, S-8) is derived by packing the contents of the ID-24 (see Section 5.7.1). Tables B-8a and B-8b illustrate the structure of the ID-24 and the S-8 products. For a description of individual PAT record elements, see Table A-2, or refer to the PAT User's Guide, Reference 9.

Table B-8a. Unpacked Processed Archival Tape (ID-24, PAT60)

FILE NUMBER	RECORD NUMBER	CONTENTS	DESCRIPTION
1	1	ERBE physical header	See Reference 5.
2	1 through end-of-file	(XPAT(I), I=1,3630)	PAT60 data records. File 2 contains up to 5400 data records.

Table B-8b. Processed Archival Tape (S-8)

FILE NUMBER	RECORD NUMBER	CONTENTS	DESCRIPTION
1	1	ERBE physical header	See Reference 5.
2		(IPPAT(I), I=1,912)	PAT test record in packed integers.
3	1	(IPPAT(I), I=1,912)	PAT scale factors in packed integers.
	2	(IPPAT(I), I=1,912)	PAT offsets in packed integers.
4	1 through end-of-file	(IPPAT(I), I=1,912)	PAT data record in packed integers. File 4 contains up to 5400 data records.

B.10 MAIN-PROCESSOR PROCESSING SUMMARY (QC-7)

The Inversion Subsystem Main-Processor Processing Summary is generated in subroutine INVPS (#5.4.2). The primary inputs to this subroutine are the variables contained in the COMMON Block /REPORT/ (see Table F-34). Figure B-2 shows an example of the processing summary for the Main-Processor.

```
1                                          INVERSION MAIN PROGRAM PROCESSING SUMMARY

                  PAGE: 1                                                                   ERBE PRODUCT: QC - 7
                                                                                         DATE PROCESSED: 93/10/26.
             SATELLITE: ERBS                                                              TEMPORAL SPAN: 90/01/01 0000 - 90/01/01 2359
            INSTRUMENT: BOTH                                                             SYSTEM RELEASE: 3
               CHANNEL: ALL                                                            SOFTWARE VERSION: 16
                 UNITS: VARIOUS                                                           DATA ALTITUDE: TOA
0
 *********************
     ORBIT AND DATA
 *********************

                            BLACKOUT                                                                            OPENED CLOSED CLOSED MAX REMAIN
                                                                                                                       NORMAL FINAL
 NO. 16 SEC RECORDS   5395  START( TIME COLAT  LONG)  STOP(  TIME COLAT  LONG) LENGTH   ACTIVE 2.5 REG   25291  25274    17   38     0
 PERCENT FULL RECORDS   99   1 38  6.95  75.1 113.3    1 38 37.94  76.7 114.3    .52   NADIR  5.0 REG    1469   1450     0   35    19
 COMPUTER TIME (MIN)    18   4 11  9.94  79.7 271.3    4 11 25.94  78.9 271.8    .27   NADIR 10.0 REG     790    780     0   19    10
 WALL TIME (MIN)        28  19 55 25.94 141.1 331.5   19 55 41.94 140.6 332.8    .27   HISTOGRAM  REG       0      0     0    0     0
 ALTITUDE FINAL      566.8   5 21 49.94 146.5 167.1    5 22  5.94 146.4 168.8    .27
 CIRCULAR              YES   0  0   .00    .0    .0    0  0   .00    .0    .0    .00
 INVERT SCAN DATA      YES
 IDENTIFY SCAN SCENE   YES                                                             SWITCH TIME (MIN)          30.000000
 OUTPUT SCAN TO DAILY  YES  NO. OF DATA BLACKOUTS                                   4   NO. SCENE VAL POINTS              18
 INVERT NONSCAN DATA   YES  NO. OF SCAN NS SWITCHES                                87   NO. EARTH TARGET POINTS            4
 OUTPUT NS TO DAILY    YES  NO. OF SCAN SCENE IDENTIFIED UNKNOWN                  102   EARTH SPIN (DEG/SEC)         .004178
 SCENE VALIDATION DAY  NO   NO. OF SCAN EST REJECTED ON MIN ALBEDO    (   .02)      0   SOLAR CONSTANT (W/M**2)  1365.000000
 OUTPUT SCENE VAL DATA NO   NO. OF SCAN EST REJECTED ON MAX ALBEDO    (  1.00)    113   ALTITUDE TOA (KM)          30.000000
 OUTPUT HISTOGRAMS     NO   NO. OF LW SCAN EST REJECTED ON MIN RAD EX ( 50.00)      0   RADIUS OF EARTH (KM)     6371.017000
 OUTPUT PAT TO POST    YES  NO. OF LW SCAN EST REJECTED ON MAX RAD EX (400.00)      0   PI                          3.141593
 OUTPUT NS DATA TAPE   NO   NO. OF SCAN MEAS REJECTED ON MAX VIEW ZEN ( 70.00)  88415   DEG TO RAD CONVERSION      .017453
 OUTPUT EARTH TARGET   YES  NO. OF SCAN MEAS REJECTED ON MAX BIDIRECT (  2.00)     34   RAD TO DEG CONVERSION      57.295780
                            NO. OF SCAN MEAS REJECTED ON ID SIGMA     (  8.00)      2   SEMI-MAJOR AXIS          6979.494285
                            NO. OF SCAN MEAS REJECTED ON CONSISTENCY  ( 10.00)     66   ECCENTRICITY                .001931
                            BAD SCANNER RECORD LEVEL FLAGS                          3   ARGUMENT OF PERIGEE        87.627867
                            BAD NONSCANNER RECORD LEVEL FLAGS                       0   TRUE ANOMOLY               69.786343
                                                                                        INCLINATION                57.009604
                                                                                        LONG OF ASCENDING NODE    -31.934781
                                                                                        ORBITAL PERIOD             96.715383
```

Figure B-2. QC-7 Processing Summary Report (1 of 7)

PAGE: 2

SATELLITE: ERBS
INSTRUMENT: BOTH
CHANNEL: ALL
UNITS: COUNTS, PERCENT

ERBE PRODUCT: QC - 7
DATE PROCESSED: 93/10/26.
TEMPORAL SPAN: 90/01/01 0000 - 90/01/01 2359
SYSTEM RELEASE: 3
SOFTWARE VERSION: 16
DATA ALTITUDE: TOA

****
SAMPLING AND SCENE
****

	***** NUMBER SAMPLED	GOOD MEAS		*****	* GEOGRAPHIC		SAMPLED/MODELED *			**** CLOUDS ****					***** CLR ****					** PC **			** MC **			OV
COLAT	SW(DA)	LW	TOT	DA/NT	OCEAN	LAND	SNOW	DESERT	MIX	CLR	PC	MC	OV	AMT	O	L	S	D	M	O	L	M	O	L	M	OV
N	0	0	0	0/ 0	0/ 0	0/ 0	0/100	0/ 0	0/ 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	607	607	0/100	17/13	0/ 0	82/ 87	0/ 0	1/ 0	3	0	0	97	95	0	0	3	0	0	0	0	0	0	0	0	97
3	0	25242	25242	0/100	18/15	1/ 1	77/ 81	0/ 0	4/ 3	25	1	8	66	71	0	0	24	0	0	0	1	0	6	1	1	67
4	149	127338	127338	0/ 99	37/38	7/ 6	51/ 51	0/ 0	5/ 5	25	2	27	46	66	0	0	25	0	0	1	1	0	18	5	4	46
5	8682	119703	119761	7/ 92	45/45	22/23	19/ 18	7/ 7	7/ 7	11	7	50	32	70	0	0	10	1	0	3	3	1	26	19	4	33
6	36019	92241	93354	38/ 61	53/53	25/26	3/ 2	12/12	7/ 7	8	24	39	29	63	1	1	0	5	0	13	10	2	22	14	3	29
7	41296	84222	85608	48/ 51	59/60	14/14	0/ 0	21/21	6/ 5	28	39	21	12	38	8	2	0	17	2	25	10	3	16	4	1	12
8	41238	83255	83705	49/ 50	71/70	13/13	0/ 0	10/10	6/ 7	36	42	14	8	30	20	5	0	9	2	29	8	4	13	1	1	8
9	41449	84076	84085	50/ 49	76/76	18/18	0/ 0	2/ 2	4/ 4	14	45	27	14	46	9	3	0	1	0	37	8	1	21	5	1	14
10	41766	84414	84414	50/ 49	74/74	20/20	0/ 0	1/ 1	5/ 5	18	30	25	27	53	16	1	0	0	0	26	4	1	18	6	1	27
11	42773	85854	85854	50/ 49	75/76	18/17	0/ 0	3/ 3	4/ 4	17	34	25	24	51	14	1	0	1	1	29	4	1	18	6	1	24
12	44750	89239	89239	50/ 49	76/76	12/11	0/ 0	9/10	3/ 3	28	41	18	13	38	18	3	0	6	1	33	7	1	15	3	0	13
13	58408	97431	97532	60/ 39	85/88	8/ 7	0/ 0	3/ 2	4/ 3	18	41	29	12	44	13	3	0	2	1	33	4	2	27	2	1	12
14	112069	120192	121719	92/ 7	96/96	1/ 1	0/ 0	1/ 1	2/ 2	9	25	44	22	60	9	0	0	0	0	24	1	1	41	1	1	22
15	124866	123195	125619	99/ 0	98/98	1/ 1	0/ 0	0/ 0	1/ 1	2	11	52	35	75	2	0	0	0	0	11	0	0	52	0	0	35
16	25583	25278	25685	100/ 0	95/87	0/ 0	2/ 7	0/ 0	3/ 6	1	2	41	56	85	0	0	1	0	1	2	0	0	40	0	1	55
17	666	659	666	100/ 0	43/27	0/ 0	51/ 67	0/ 0	6/ 6	1	0	4	95	96	0	0	1	0	0	0	0	0	3	0	0	96
S	0	0	0	0/ 0	0/ 4	0/ 0	0/ 95	0/ 0	0/ 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GLOB	619714	1242946	1250428	50/ 50						17	26	31	26	55	8	1	4	2	0	19	4	1	25	5	1	30
BAD	3317	94270	86788																							
TOT	623031	1337216	1337216																							

Figure B-2. QC-7 Processing Summary Report (2 of 7)

1 INVERSION MAIN PROGRAM PROCESSING SUMMARY

PAGE: 3

ERBE PRODUCT: QC - 7
DATE PROCESSED: 93/10/26.

SATELLITE: ERBS
INSTRUMENT: BOTH
CHANNEL: ALL
UNITS: COUNTS, PERCENT

TEMPORAL SPAN: 90/01/01 0000 - 90/01/01 2359
SYSTEM RELEASE: 3
SOFTWARE VERSION: 16
DATA ALTITUDE: TOA

0

	********* DAY *********						******** NIGHT *********					
V.ZEN	NUM	CLR	PC	MC	OV	AMT	NUM	CLR	PC	MC	OV	AMT
0-15	21	19	26	35	20	53	21	20	24	27	28	54
15-27	17	19	27	35	20	53	17	20	25	28	27	54
27-39	17	18	26	35	21	53	17	19	25	29	26	54
39-51	15	15	27	36	22	55	16	20	25	29	27	55
51-63	15	13	27	37	23	57	15	17	25	27	31	57
63-75	11	10	29	35	27	60	11	11	25	29	34	61
75-90	3	1	25	38	36	70	3	4	15	33	48	75
TOTAL	100	16	27	35	22	55	100	18	24	28	29	56

S.ZEN	NUM	CLR	PC	MC	OV	AMT
0-26	24	24	34	30	12	43
26-37	15	10	25	39	25	60
37-46	11	13	23	38	27	61
46-53	9	14	26	35	25	57
53-60	8	18	24	34	24	55
60-66	7	18	22	36	24	56
66-73	7	16	26	39	19	54
73-78	7	14	25	36	25	58
78-84	7	12	23	37	29	62
84-90	6	7	27	38	28	62
TOTAL	100	16	27	35	22	55

SELECTED SCENE SIGMA DEPARTURE

SIGMA	NUM	SIGMA	NUM	SIGMA	NUM
1	814331	11	0	21	0
2	388308	12	0	22	0
3	44247	13	0	23	0
4	3117	14	0	24	0
5	285	15	0	25	0
6	60	16	0	26	0
7	19	17	0	27	0
8	17	18	0	28	0
9	1	19	0	29	0
10	1	20	0	30 +	0

(MEAS TOO HOT) LW SIGMA OF SELECTED SCENE (MEAS TOO COLD)

		.GT.6	5TO6	4TO5	3TO4	2TO3	1TO2	0TO1	ALL LW	0TO-1	-1TO-2	-2TO-3	-3TO-4	-4TO-5	-5TO-6	.LT.-6
	.GT.6	0	0	0	0	11	0	1	23	9	0	2	0	0	0	0
B	5TO6	0	0	0	0	0	1	7	34	21	4	1	0	0	0	0
R	4TO5	0	0	0	0	0	1	19	103	44	36	3	0	0	0	0
I S	3TO4	0	0	0	0	3	14	65	405	150	116	57	0	0	0	0
G W	2TO3	0	0	0	1	63	904	3152	9476	2071	2454	725	106	0	0	0
H	1TO2	0	0	1	13	393	8483	39198	96503	35479	11825	1058	53	0	0	0
T S	0TO1	0	2	8	53	743	22000	85160	225555	84959	31002	1623	5	0	0	0
I																
G	ALL SW	0	2	9	129	2508	62146	451718	0	537518	178602	17347	407	0	0	0
M																
A	0TO-1	0	0	0	50	497	12487	85319	235844	95328	38256	3903	4	0	0	0
	-1TO-2	0	0	0	5	131	1255	12481	52420	30281	7834	420	13	0	0	0
D	-2TO-3	0	0	0	7	43	155	617	2104	708	566	8	0	0	0	0
A	-3TO-4	0	0	0	0	15	62	109	369	95	88	0	0	0	0	0
R	-4TO-5	0	0	0	0	1	1	5	68	36	25	0	0	0	0	0
K	-5TO-6	0	0	0	0	0	0	1	15	6	8	0	0	0	0	0
	.LT.-6	0	0	0	0	0	0	0	12	1	11	0	0	0	0	0
	NIGHT	0	0	0	0	608	16783	225584	627455	288330	86377	9547	226	0	0	0

Figure B-2. QC-7 Processing Summary Report (3 of 7)

PAGE: 4

SATELLITE: ERBS
INSTRUMENT: BOTH
CHANNEL: ALL
UNITS: W/M**2, COUNTS, PERCENT

ERBE PRODUCT: QC - 7
DATE PROCESSED: 93/10/26.
TEMPORAL SPAN: 90/01/01 0000 - 90/01/01 2359
SYSTEM RELEASE: 3
SOFTWARE VERSION: 16
DATA ALTITUDE: TOA

****
TOA ESTIMATES
****

	**** SCAN(2.5) ****			WFOV								MFOV							
				SF			NF			MEAS		SF			NF			MEAS	
COLAT	SW/N	LW/N	ALB	SW/N	LW/N	ALB	SW/N	LW/N	ALB	SW	LW	SW/N	LW/N	ALB	SW/N	LW/N	ALB	SW	LW
N	0/ 0	0/ 0	0	0/ 0	0/ 0	0	0/ 0	0/ 0	0	0	0	0/ 0	0/ 0	0	0/ 0	0/ 0	0	0	0
2	0/ 0	0/ 0	0	0/ 0	0/ 0	0	0/ 0	0/ 0	0	0	0	0/ 0	0/ 0	0	0/ 0	0/ 0	0	0	0
3	0/ 0	170/ 1288	0	0/ 0	0/ 0	0	0/ 0	0/ 0	0	0	0	0/ 0	0/ 0	0	0/ 0	0/ 0	0	0	0
4	0/ 0	186/ 2693	0	0/ 0	190/ 321	0	0/ 0	191/ 202	0	0	159	0/ 0	191/ 361	0	0/ 0	191/ 361	0	0	83
5	78/ 150	199/ 2714	58	0/ 0	201/ 238	0	0/ 0	203/ 176	0	6	168	0/ 0	204/ 238	0	0/ 0	205/ 232	0	0	89
6	115/ 531	215/ 1726	46	80/ 76	220/ 197	42	0/ 0	217/ 197	0	34	184	83/ 76	221/ 197	44	0/ 0	221/ 197	0	11	96
7	161/ 694	256/ 1436	36	150/ 87	253/ 180	32	162/ 79	255/ 180	34	60	212	151/ 87	260/ 180	32	149/ 76	261/ 177	31	24	113
8	190/ 662	274/ 1323	27	187/ 90	268/ 181	25	182/ 84	270/ 175	25	75	224	185/ 89	276/ 180	25	178/ 79	276/ 170	24	31	120
9	222/ 644	254/ 1282	23	215/ 90	257/ 180	22	223/ 84	258/ 174	23	87	215	211/ 91	265/ 181	22	214/ 86	265/ 176	22	40	115
10	275/ 651	240/ 1292	24	255/ 89	240/ 179	22	218/ 78	242/ 168	19	105	201	247/ 90	246/ 180	22	247/ 90	246/ 180	21	50	107
11	286/ 683	245/ 1363	23	278/ 89	246/ 180	22	289/ 84	245/ 97	23	115	206	278/ 91	254/ 182	22	278/ 91	254/ 182	22	59	110
12	264/ 760	266/ 1513	20	260/ 97	260/ 153	19	250/ 95	266/ 95	18	143	218	246/ 97	270/ 192	18	241/ 97	270/ 192	18	52	117
13	245/ 1130	255/ 1845	24	286/ 101	251/ 202	21	285/ 100	251/ 155	21	125	210	288/ 101	259/ 202	21	290/ 101	259/ 202	21	61	112
14	271/ 2458	234/ 2798	35	243/ 204	229/ 240	36	319/ 113	230/ 228	25	183	191	254/ 206	231/ 242	38	345/ 121	233/ 242	27	89	101
15	328/ 2693	221/ 2709	43	330/ 361	213/ 361	40	334/ 334	214/ 338	40	273	178	342/ 364	217/ 364	42	343/ 359	217/ 364	42	132	94
16	411/ 1308	211/ 1308	52	0/ 0	0/ 0	0	0/ 0	0/ 0	0	0	0	0/ 0	0/ 0	0	0/ 0	0/ 0	0	0	0
17	0/ 0	0/ 0	0	0/ 0	0/ 0	0	0/ 0	0/ 0	0	0	0	0/ 0	0/ 0	0	0/ 0	0/ 0	0	0	0
S	0/ 0	0/ 0	0	0/ 0	0/ 0	0	0/ 0	0/ 0	0	0	0	0/ 0	0/ 0	0	0/ 0	0/ 0	0	0	0
GLOB	232/12364	237/25290	30	225/1284	239/2612	26	245/1051	240/2185	24	106	193	224/1292	245/2699	27	246/1100	245/2675	24	49	102

Figure B-2. QC-7 Processing Summary Report (4 of 7)

PAGE: 5

SATELLITE: ERBS
INSTRUMENT: BOTH
CHANNEL: ALL
UNITS: W/M**2

ERBE PRODUCT: QC - 7
DATE PROCESSED: 93/10/26.
TEMPORAL SPAN: 90/01/01 0000 - 90/01/01 2359
SYSTEM RELEASE: 3
SOFTWARE VERSION: 16
DATA ALTITUDE: TOA

0
****
SCAN-NON SCAN DIFF
****

	************ SW DIFFERENCES **********								************ LW DIFFERENCES **********							
	SCAN	SCAN	SCAN	SCAN	WFOV NF	WFOV NF	WFOV SF	MFOV NF	SCAN	SCAN	SCAN	SCAN	WFOV NF	WFOV NF	WFOV SF	MFOV NF
	MINUS															
COLAT	WFOV SF	WFOV NF	MFOV SF	MFOV NF	WFOV SF	MFOV NF	MFOV SF	MFOV SF	WFOV SF	WFOV NF	MFOV SF	MFOV NF	WFOV SF	MFOV NF	MFOV SF	MFOV SF
N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	170	170	170	170	0	0	0	0
4	0	0	0	0	0	0	0	0	-4	-5	-5	-5	1	0	-1	0
5	78	78	78	78	0	0	0	0	-2	-4	-5	-6	2	-2	-3	1
6	35	115	32	115	-80	0	-3	-83	-5	-2	-6	-6	-3	-4	-1	0
7	11	-1	10	12	12	13	-1	-2	3	1	-4	-5	2	-6	-7	1
8	3	8	5	12	-5	4	2	-7	6	4	-2	-2	2	-6	-8	0
9	7	-1	11	8	8	9	4	3	-3	-4	-11	-11	1	-7	-8	0
10	20	57	28	28	-37	-29	8	0	0	-2	-6	-6	2	-4	-6	0
11	8	-3	8	8	11	11	0	0	-1	0	-9	-9	-1	-9	-8	0
12	4	14	18	23	-10	9	14	-5	6	0	-4	-4	6	-4	-10	0
13	-41	-40	-43	-45	-1	-5	-2	2	4	4	-4	-4	0	-8	-8	0
14	28	-48	17	-74	76	-26	-11	91	5	4	3	1	1	-3	-2	2
15	-2	-6	-14	-15	4	-9	-12	1	8	7	4	4	1	-3	-4	0
16	411	411	411	411	0	0	0	0	211	211	211	211	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GLOB	7	-13	8	-14	20	-1	1	22	-2	-3	-8	-8	1	-5	-6	0

Figure B-2. QC-7 Processing Summary Report (5 of 7)

```
PAGE: 6                                  ERBE PRODUCT: QC - 7
                                     DATE PROCESSED: 93/10/26.
SATELLITE: ERBS                       TEMPORAL SPAN: 90/01/01 0000 - 90/01/01 2359
INSTRUMENT: BOTH                     SYSTEM RELEASE: 3
CHANNEL: ALL                       SOFTWARE VERSION: 16
UNITS: W/M**2                         DATA ALTITUDE: TOA
```

****
SW OFFSETS
****

```
                                   YY/MM/DD - HH/MM/SS
INITIAL TIME FROM INPUT-PAT HEADER     90  1  1    0  0 14.94
```

*** OFFSETS ***

ORBIT NO.	NFOV	MFOV	WFOV	*	TIME DIFF (MIN)
1	.106	-1.002	-.530	*	81.067
2	.111	-.784	-.395	*	96.783
3	.177	-.337	.028	*	96.533
4	.164	-.675	-.722	*	96.800
5	.151	-.764	-.597	*	96.533
6	.190	-.822	-.642	*	96.533
7	.225	-.758	-.499	*	96.800
8	.083	-.749	-.609	*	96.533
9	.137	-1.095	-.820	*	96.533
10	.239	-1.271	-.669	*	96.800
11	.121	-.934	-.563	*	96.533
12	.071	-1.304	-.988	*	96.800
13	.002	-1.193	-.991	*	96.533
14	.116	-1.233	-.585	*	96.800
15	.197	-.676	-.450	*	96.533
REJECTS DUE TO INSUFFICIENT DATA (200,20,20)	0	0	0		
REJECTS DUE TO EXCEEDING LIMIT (5)	0	0	0		

```
NIGHTTIME TO NIGHTTIME DATA DROP OUT PERIODS     0
DAYTIME   TO DAYTIME   DATA DROP OUT PERIODS     0
NIGHTTIME TO DAYTIME   DATA DROP OUT PERIODS     0
```

Figure B-2. QC-7 Processing Summary Report (6 of 7)

1 INVERSION MAIN PROGRAM PROCESSING SUMMARY

PAGE: 7
SATELLITE: ERBS
INSTRUMENT: BOTH
CHANNEL: ALL
UNITS: VARIOUS

ERBE PRODUCT: QC - 7
DATE PROCESSED: 93/10/26.
TEMPORAL SPAN: 90/01/01 0000 - 90/01/01 2359
SYSTEM RELEASE: 3
SOFTWARE VERSION: 16
DATA ALTITUDE: TOA

****
EARTH TARGET VALIDATION
REGION SUMMARY
****

INDEX	2.5-DEG REGION NO.	NO. OF OCCURRENCES
1	3909	118
2	6673	145
3	3749	228
4	3411	141

0
0
****
MAIN-PROCESSOR
IBUF ARRAYS
****
0

	PRE-PAT/ID3	SCAN TO DDB/ID6	NS TO DDB/ID7	HISTOGRAMS/ID8	ETVD/ID13	PAT*/ID20	PPOUT/ID21
1	51822447892501	50122447892565	50222447892516	0	50722447892563	51222447892578	51322447892000
2	2	2	2	0	2	2	2
3	2447892	2447892	2447892	0	2447892	2447892	2447892
4	500172973	500172973	500172973	0	500172973	500172973	500172973
5	2447893	2447893	2447893	0	2447893	2447893	2447893
6	499976122	499976122	499976122	0	499976122	499976122	499976122
7	2	1	1	0	1	2	1
8	5395	25291	2700	0	632	5395	1

Figure B-2. QC-7 Processing Summary Report (7 of 7)

B.11 POST-PROCESSOR PROCESSING SUMMARY (QC-27)

The Inversion Subsystem Post-Processor Processing Summary is produced in subroutine INPPPS (#5.5.3). The information contained in this report includes the date of the data processed, information regarding which output products were requested, the number of records written to the output products, and the logical header records from the input and output products.

Figure B-3 contains an example of this processing summary.

Figure B-3. QC-27 Processing Summary Report (1 of 2)

Figure B-3. QC-27 Processing Summary Report (2 of 2)

B.12 MONTHLY-PROCESSOR PROCESSING SUMMARY (QC-44)

The Inversion Subsystem Monthly-Processor Processing Summary is output by subroutine SUMMRY, #5.6.3. The information contained in this report includes the product generated (S-7 or V-6), how many daily files are on the output tape, which files are new, and which old files were replaced with new data. Record counts for each daily file are also given. Logical header records for the input and output tapes are also listed.

Figures B-4a and B-4b show examples of the Monthly-Processor processing summary reports for both the S-7 and V-6 products.

Figure B-4a. QC-44 Processing Summary Report (S-7) (1 of 2)

Figure B-4a. QC-44 Processing Summary Report (S-7) (2 of 2)

Figure B-4b. QC-44 Processing Summary Report (V-6) (1 of 2)

Figure B-4b. QC-44 Processing Summary Report (V-6) (2 of 2)

APPENDIX C

INVERSION SUBSYSTEM COPY PROCEDURES

Inversion Subsystem copy procedures allow a user to generate duplicate tape copies of selected inversion Subsystem products. These copy procedures are used to generate product copies to be sent to off-site facilities as well as to generate back-up copies of frequently used products kept locally at NASA Langley Research Center (NASA/LaRC).

The entry point for creating product copies is an interactive procedure, INV, that presents Inversion Subsystem processing options in menu form. Through this menu procedure, a user can select a specific product to duplicate. Once the product selection is made, prompts are provided to gather all appropriate information necessary to complete a product copy. In each case, the user is prompted for an input tape volume serial number (VSN). For product copies held locally, a prompt is provided for output tape VSN. Tape copies designated for off-site distribution are assigned a VSN according to naming conventions that uniquely define the product data set (see Appendix H). The interactive procedure will prompt the user for satellite code, data date, version number, and copy number, and then compute the appropriate VSN.

Once the JCL for a copy procedure has been generated and submitted for execution by INV, a call will be made to the appropriate copy procedure on PINVSS, a multiprocedure file that drives execution of all Inversion Subsystem jobs.

For an in-depth description of the Inversion Subsystem menu procedure, INV, execution driver, PINVSS, sample menu sessions, and JCL file examples, refer to the Inversion Subsystem Operators’ Guide (see Reference 11).

APPENDIX D

INVERSION SUBSYSTEM DUMP PROGRAMS

Appendix D contains narratives, functional structure diagrams, and flowcharts of software that has been developed to list selected records from various Inversion Subsystem products.

See Section A.8 for packing equation used in generating the ID-25 and S-8 products.

D.1 UNPACKED PROCESSED ARCHIVAL TAPE (PAT60, ID-24) DUMPING (SIDI24)

Program SIDI24 lists selected records from the PAT60 (ID-24). The PAT60, generated by the Inversion Subsystem Post-Processor, consists of a standard ERBE header and a file of up to 5400 unpacked PAT data records. SIDI24 prints the ERBE header information followed by the contents of a user-designated set of records. The data records are displayed in columnar form, in groups of up to 10 records. Figure D-1 contains the PAT60 dumping functional structure chart. The flowchart of SIDI24 is shown in Figure D-2. Table B-8a contains the structure of the PAT60 product.

PAT60 listing logic involves initialization, header processing, positioning the PAT60 to the appropriate record for listing, and then reading and printing selected data records. This processing is implemented as described by the following detailed steps.

SIDI24 begins with a call to INUTIL (#G.E.8.2.1) to initialize system utilities. NAMELIST file $NIPU01, containing unit numbers and subsystem constants, is then read. See Table A-8i for the structure and contents of $NIPU01. ERBE header processing then follows. Routine GBFHED (#G.E.8.3.19) is invoked to retrieve the PAT60 logical header. A call to PPSPEC (#G.5.20) is then made to print the PAT60 product specifications. Specifications include the following characteristics of the data: temporal span, spacecraft name, product name, volume serial number (VSN) associated with the PAT60 product, and the contents of the ERBE logical header. RECRNG (#G.5.22) is then invoked to obtain the identifiers of records to list. If the initial record identifier is returned from RECRNG with a zero value, no data record listing is requested, and program logic branches to terminate processing. This circumstance corresponds to the request to print product specifications only. If nonzero record identifiers are returned, SIDI24 proceeds to read and print the contents of the requested records.

SIDI24 uses the value of the initial record identifier in order to compute the number of data records to skip prior to printing. Records are sequentially buffered in until the PAT60 is positioned at the first requested record. Up to 10 PAT60 records are read into array **XXPAT**. The contents of array **XXPAT**

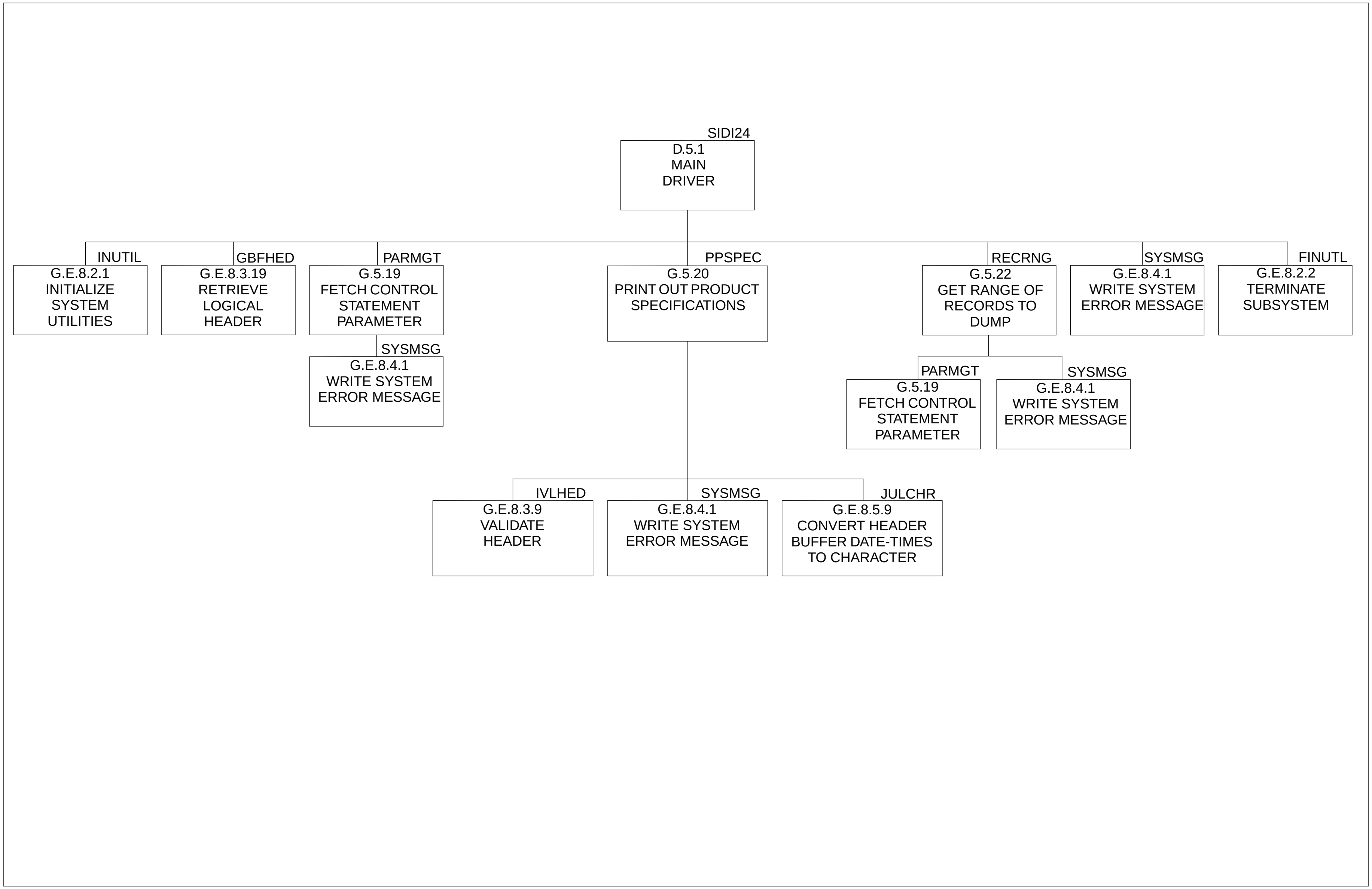


Figure D-1. PAT60 Dumping Program Functional Structure Chart

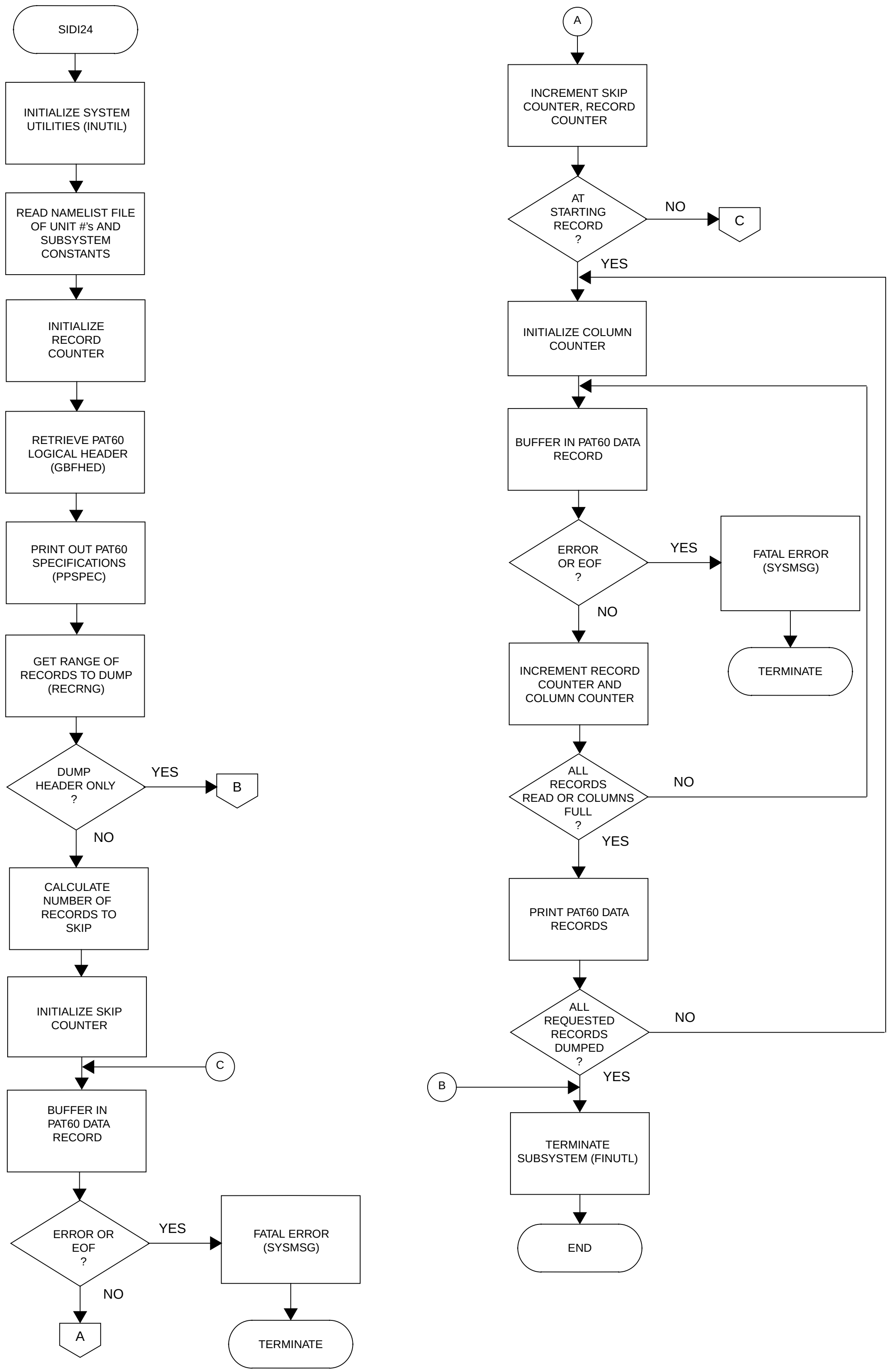


Figure D-2. Flowchart of SIDI24 (Module D.5.1) are printed once 10 records have been buffered in or after the final requested record has been processed. After the printing of **XXPAT** is accomplished, a test is made to see if all requested records have been printed. If more records are to be listed, SIDI24 continues to buffer in and print the data records in groups of 10. When all requested records have been printed, the normal terminating condition has been met, and routine FINUTL (#G.E.8.2.2) is invoked to terminate processing.

D.2 PACKED SCANNER AND NONSCANNER SCENE VALIDATAION DATA (ID-25) DUMPING (SIDI25)

Program SIDI25 lists scene validation data from the ID-25 product. The ID-25, generated by packing the contents of the ID-4 product, consists of records containing the standard ERBE header, validation time and region information, packed scale factors and offsets, and a variable number of associated data records. Each data record is comprised of seven words of region information, followed by a PAT record. Program SIDI25 reads and prints the header contents, validation time and region information, scale factors and offsets, and the regions information associated with each PAT record. The contents of the PAT data records are listed selectively, based on the user's request. Figure D-3 contains the ID-25 dumping functional structure chart. The flowchart of SIDI25 is shown in Figure D-4. Table B-2b illustrates the file structure of the ID-25.

SIDI25 processing begins with a call to INUTIL (#G.E.8.2.1) to initialize system utilities. NAMELIST file $NIPU01, containing unit numbers and subsystem constants, is then read. See Table A-8i for the structure and contents of $NIPU01. ERBE header processing follows. Routing G16HED (#G.E.8.3.2) is invoked to retrieve the ID-25 logical header. A call to PPSPEC (#G.5.20) is then made to print the ID-25 product specifications. Specifications include the following characteristics of the data: temporal span, spacecraft name, product name, volume serial number (VSN) associated with the ID-25 product, and the contents of the ERBE logical header. RECRNG (#G.5.22) is then invoked to obtain the identifiers of PAT records to list. If the initial record identifier is returned from RECRNG with a zero value, no data record listing is performed, and program logic branches to terminate processing. This circumstance corresponds to the request to print ID-25 product specifications only. If nonzero record identifiers are returned, SIDI25 reads NDIM21, the number of validation time intervals. **VDTIM**, the array containing the validation time table, is then read and printed. Next, NVTPS, the number of validation regions is read, followed by the reading of arrays containing the validation region numbers (**NVREG**), and the validation region colatitudes (**VCOLAT**) and longitudes (**VLONG**). The contents of **NVREG**, **VCOLAT**, and **VLONG** are then printed. Scale factor and offset processing

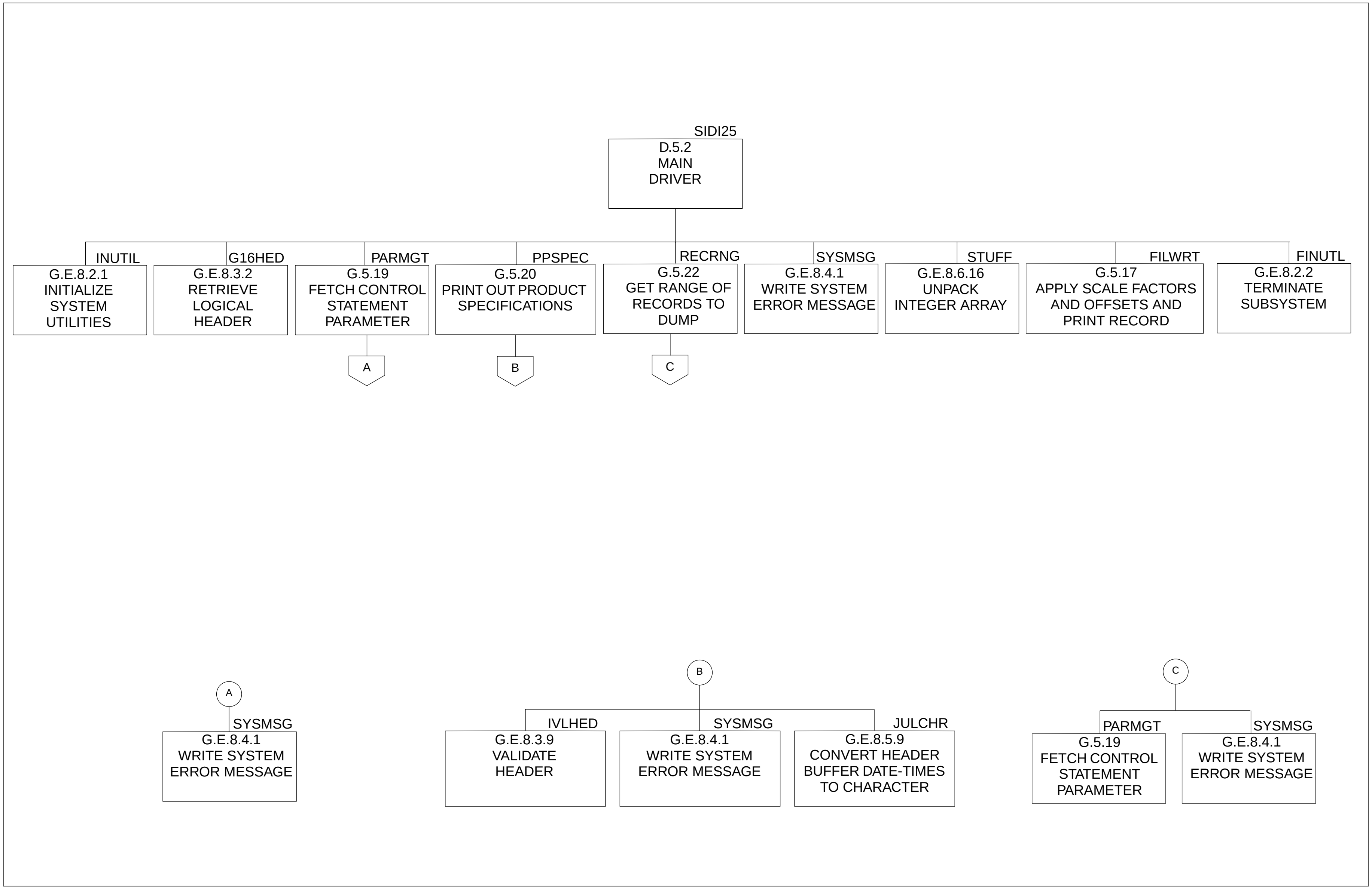


Figure D-3. ID-25 Dumping Program Functional Structure Chart

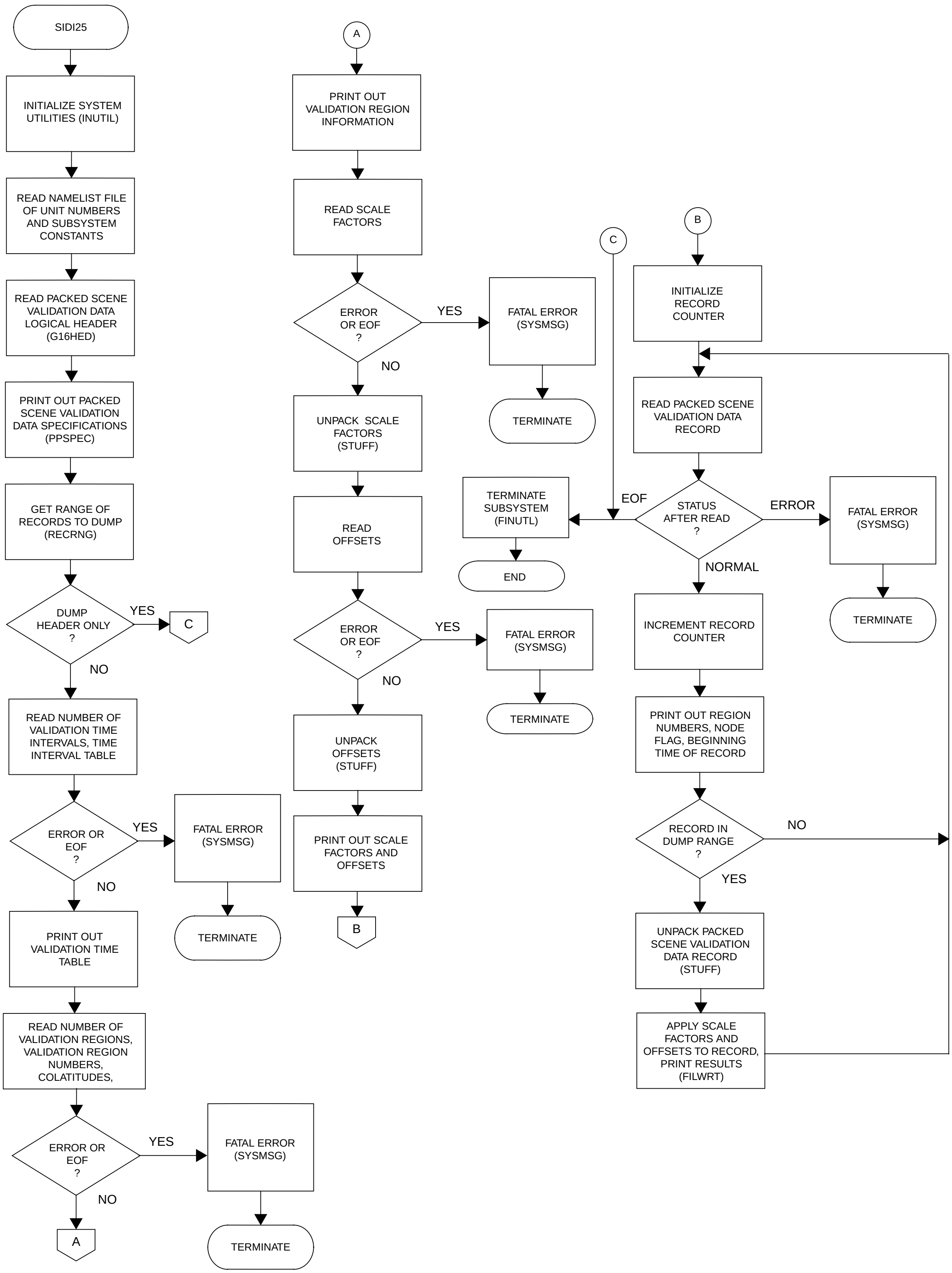


Figure D-4. Flowchart of SIDI25 (Module D.5.2) follows. Scale factors are read and unpacked through a call to STUFF (#G.E.8.6.16). Offsets are next read, and STUFF is invoked to perform offset unpacking. Both scale factors and offsets are then printed.

ID-25 data records are processed sequentially. Region information for each data record is read and printed; this regional information includes IVREG, the array of region numbers applicable to the current PAT record, NODE, an ascending/descending node flag, and TIME, the beginning time associated with the current PAT data record. The contents of the PAT record are next read. If the current record identifier is within the range of records to list, a call to STUFF is made to unpack the PAT record. FILWRT (#G.5.17) is then invoked to unscale the record elements and print the record contents. Once all ID-25 data records have been processed, routine FINUTL (#G.E.8.2.2) is invoked to terminate processing.

D.3 PROCESSED ARCHIVAL TAPE (PAT, S-8) DUMPING (SIDS8)

Program SIDS8 dumps selected records from the Processed Archival Tape (PAT, S-8). The PAT, generated by packing the PAT60 (ID-24) product, contains four files. The standard ERBE logical header and a packed test record comprise the first two files. The third file contains packed scale factors and offsets. The fourth file contains the PAT data records. SIDS8 reads, processes, and prints the ERBE logical header, test record, and scale factors and offsets. PAT data records are then read, and selected records are processed and printed. Figure D-5 contains the PAT dumping functional structure chart. The flowchart of SIDS8 is shown in Figure D-6. Table B-8b illustrates the structure of the S-8 product. For a complete description of the structure and contents of the PAT data record, refer to the PAT User's Guide (see Reference 9).

SIDS8 processing begins with a call to INUTIL (#G.E.8.2.1) to initialize system utilities. NAMELIST file $NIPU01, containing unit numbers and subsystem constants, is then read. See Table A-8i for the structure and contents of $NIPU01. ERBE header processing follows. Routine G16HED (#G.E.8.3.2) is invoked to retrieve the PAT logical header. A call to PPSPEC (#G.5.20) is then made to print the PAT product specifications. Specifications include the following characteristics of the data: temporal span, spacecraft name, product name, volume serial number (VSN) associated with the PAT product, and the contents of the ERBE logical header. PRPHED (#G.5.21) is invoked to read and print the PAT physical header contents. RECRNG (#G.5.22) is next invoked to obtain identifiers of the records to list. If the initial record identifier is returned from RECRNG with a zero value, no data record listing is performed, and program logic branches to terminate processing. This circumstance corresponds to the request to print product specifications only. If nonzero record identifiers are returned, SIDS8 next reads the PAT test record; STUFF (#G.E.8.6.16) is invoked to unpack the record. Scale factors are then read and unpacked by STUFF, followed by reading the offsets and another call to STUFF for offset unpacking. FILWRT (#G.5.17) is invoked to unscale the PAT test record and write out the resultant test record contents. Scale factors and offsets are then printed.

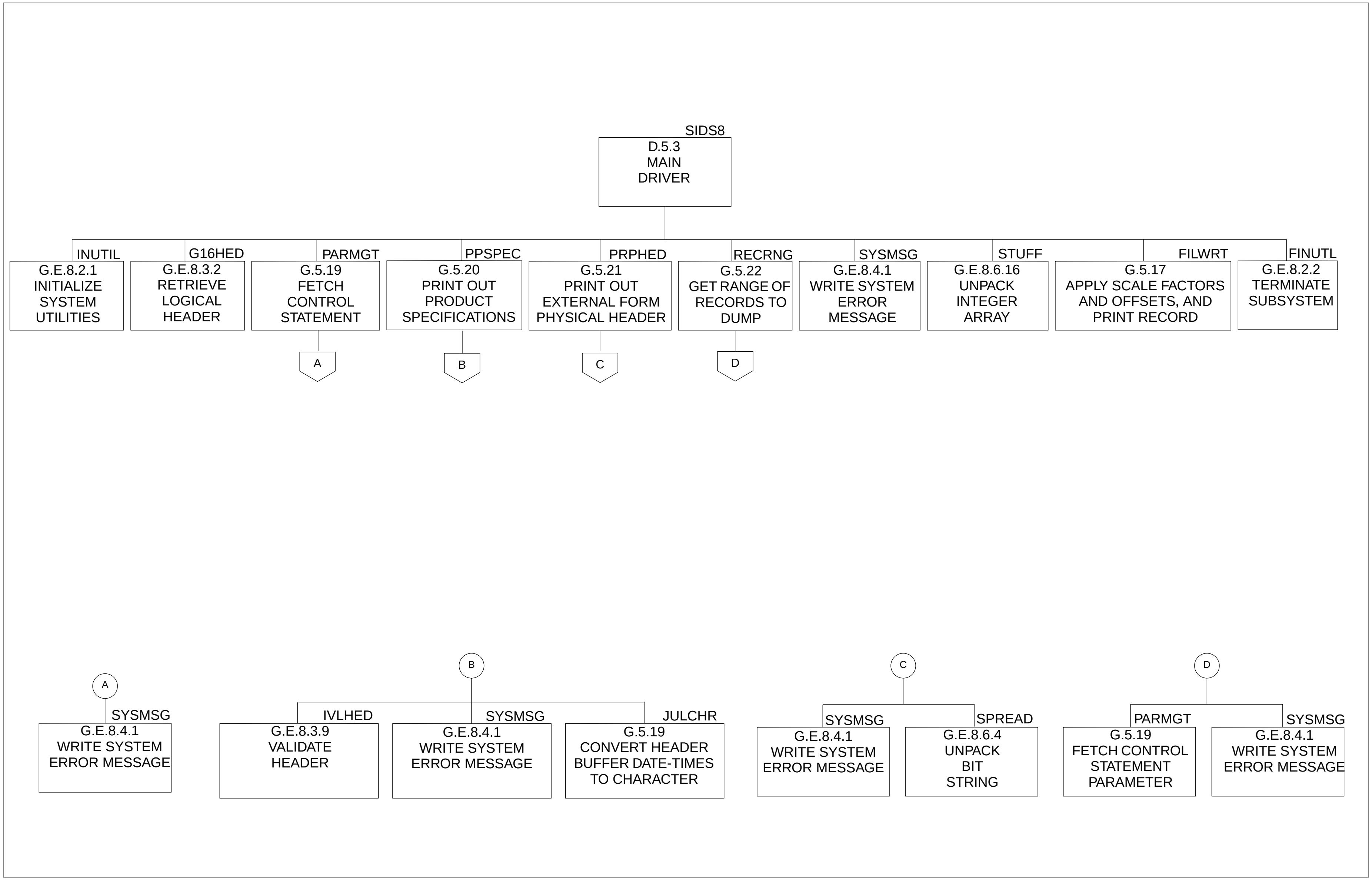


Figure D-5. S-8 Dumping Program Functional Structure Chart

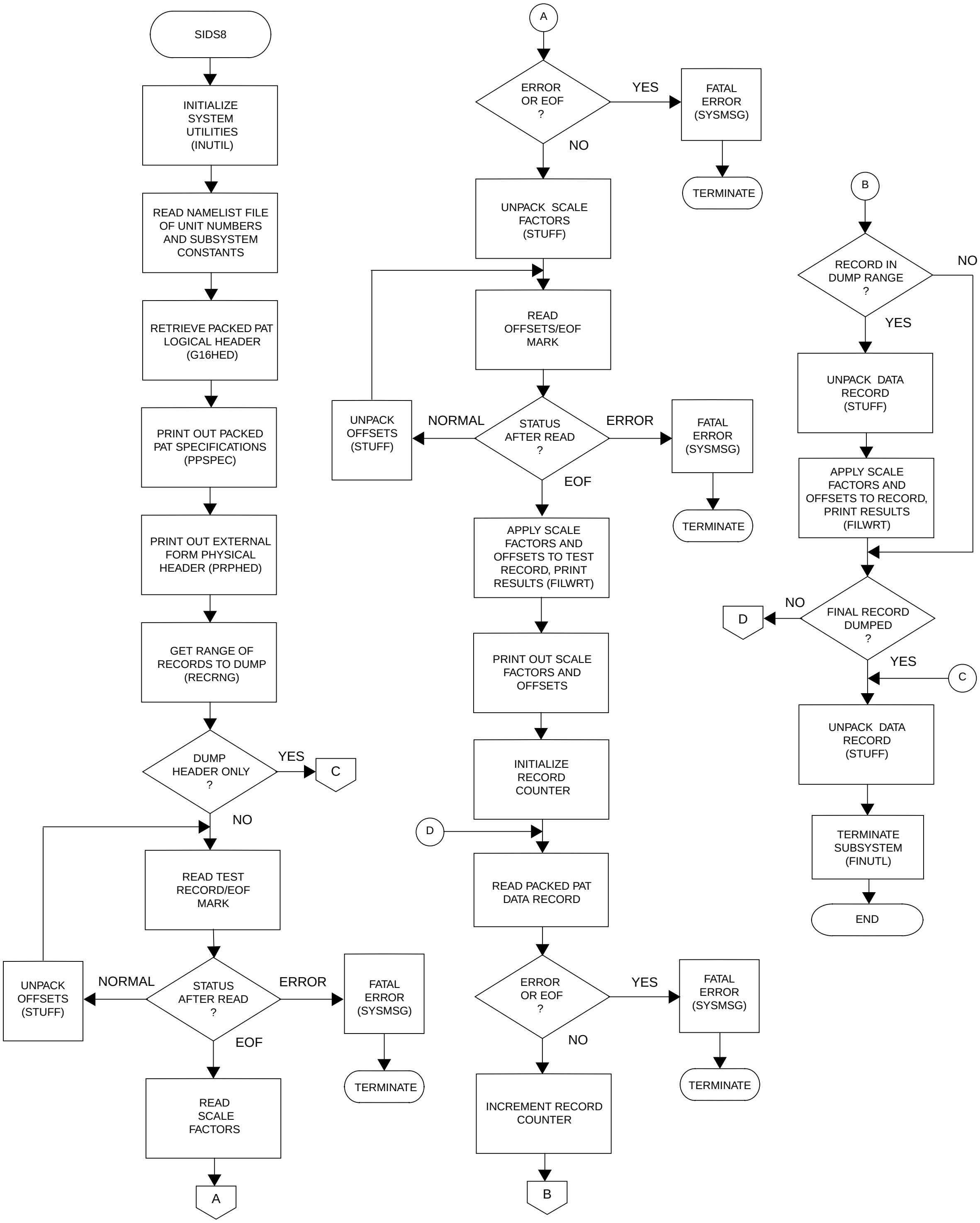


Figure D-6. Flowchart of SIDS8 (Module D.5.3)

SIDS8 next processes the PAT data records. As a PAT record is read, a record counter is incremented. If the current value of the record counter is within the range of requested records to list, STUFF is invoked to unpack the data record. FILWRT is then called to apply scale factors and offsets to the record, and print the results. A test is then made to see if all requested records have been listed. If records remain to be printed, the program logic branches to read and process the next data record. If all requested records have been processed and printed, FINUTL (#G.E.8.2.2) is invoked to terminate processing.

Note that the following FILE command is used in the job stream to define file characteristics for the S-8 product:

```
FILE,TAPE101,RT=S,BT=C,MBL=9120.
```

For a complete description of the FILE command, and how it is used to redefine system default values, see Reference 6.

APPENDIX E

SYMBOLS, ABBREVIATIONS, AND MODULE NAMES

Appendix E contains a list of symbols (Table E-1), abbreviations (Table E-2), and module names (Table E-3) used in the Inversion Subsystem Reference Manual.

Table E-1. Symbols (1 of 2)

SYMBOL	D E F I N I T I O N	UNITS
$\hat{M}$	Estimate of the radiant exitance at the TOA	wm^{-2}
m	Spacecraft altitude radiation measurement - scanner - nonscanner	$wm^{-2}sr^{-1}$ wm^{-2}
A	LW anisotropic model	
R	SW bidirectional model	
E_O	Solar constant at 1 AU	wm^{-2}
AU	Astronomical unit, the mean Earth-sun distance (1AU = 149,597,910 km)	
$l(t)$	Reciprocal of the Earth-sun distance squared at time t	AU
θ	Colatitude in the fixed Earth equatorial - Greenwich meridian coordinate system	degrees
ϕ	Longitude in the fixed Earth equatorial - Greenwich meridian coordinate system	degrees
θ_S	Colatitude of subsatellite point	degrees
ϕ_S	Longitude of subsatellite point	degrees
θ_C	Colatitude of region center	degrees
ϕ_C	Longitude of region center	degrees
ν	“Latitude” in the spacecraft aligned coordinate system	radians
η	“Longitude” in the spacecraft aligned coordinate system	radians
γ_{ij}	Quadrature weight for sub-region ij in the spacecraft aligned coordinate system	
θ_S'	Spacecraft zenith angle	degrees
θ_O'	Solar zenith angle	degrees

Table E-1. Symbols (2 of 2)

SYMBOL	D E F I N I T I O N	UNITS
μ_0'	Cosine of solar zenith angle, θ_0'	
ϕ'_r	Relative azimuth angle	degrees
$\hat{r}$	Unit radius vector	
x', y', z'	Components of the unit radius vector, $\hat{r}$	
$\underline{r}$	Radius vector	meters
x, y, z	Components of the radius vector, $\underline{r}$	meters
A	Used in the flow diagrams as a connector to A on the same page	
A-1	Used in the flow diagrams as an off-page connector to A on page 1	
$\hat{x}$	Estimate or unit vector	
$\bar{x}$	Arithmetic mean	
x	Scalar	
$\mathbf{x}$	Vector array	
$\mathbf{x}$	Matrix or 2-dimensional array	
$\mathbf{x}$	3 or more dimensional array	

Table E-2. Abbreviations (1 of 2)

ABBREVIATION	D E F I N I T I O N	UNITS
ALT	Spacecraft altitude above the TOA	meters
CR (or cr)	Clear	
ERBE	Earth Radiation Budget Experiment	
ETVD	Earth Target Validation Data	
ETVR	Earth Target Validation Region	
FJD	Fractional Julian date	days
FOV	Field-of-view	
GMT	Greenwich Mean Time	
INT	Integer (part of)	
JCL	Job control language	
LW	Longwave	
MC (or mc)	Mostly cloudy	
MFOV	Medium field-of-view	
NF	Numerical filter	
OV (or ov)	Overcast	
input-PAT	Either a pre-PAT or PAT60, whichever on a given run is used as input to the Inversion Subsystem Main-Processor (see Section A.2)	
PAT	Processed Archival Tape (S-8)	
PAT*	Partial, unpacked PAT (ID-20, see Section A.2)	
PAT60	Inversion Subsystem output product (ID-24, see Section A.2)	
pre-PAT	Merge-FOV Subsystem output product (ID-3, see Section A.2)	
PC (or pc)	Partly cloudy	

Table E-2. Abbreviations (2 of 2)

ABBREVIATION	D E F I N I T I O N	UNITS
SF	Shape factor	
SW	Shortwave	
TOA	Top of atmosphere (or reference level altitude)	
TOT	Total (instrument channel or measurement)	
TP	Target point where the scanner FOV center line intersects the TOA	
VSN	Volume serial number	
VTP	Validation time period (for ID-4)	
WFOV	Wide field-of-view	
WJD	Whole Julian date	days

Table E-3. Module Names (1 of 4)

MODULE NUMBER	MODULE NAME	C O M M E N T
5.0	INVERT	Inversion (Main Program)
5.1	STRT5	Start (subsystem) 5
5.1.1	PATVFY	PAT verify
5.1.2	PARINT	Parameter initialization
5.1.2.1	RDAT1	Read data initially
5.1.3	VALDAT	Validation data (time table generation)
5.1.4	CHKREQ	Check (unit) request
5.2	SCINV	Scanner (data) inversion
5.2.1	RDPAT	Read PAT
5.2.1.1	SWZERO	SW zero correction
5.2.2	SPCOR	Spectral correction (algorithm)
5.2.2.1	SCNID	Scene identification (algorithm)
5.2.2.1.1	XMNLW	Mean LW radiant exitance
5.2.2.1.2	XAP	Mean value of apriori probability statistics
5.2.3	ETVOUT	Earth target validation (data) output
5.2.4	SCTOA	Scanner TOA (estimate calculations)
5.2.5	SCACUM	Scanner accumulation (of regional statistics)
5.2.6	SCFIN	Scanner finalize (for current data time frame)
5.3	NSINV	Nonscanner (data) inversion
5.3.1	NSREG	Nonscanner regular (data processing)
5.3.1.1	DATNS	Data nonscanner (retrieved from **XPATNS** array)
5.3.1.1.1	AXTRAN	Axis transformation
5.3.1.1.2	DSHIFT	Data shift
5.3.1.2	INFLCO	Influence coefficients
5.3.1.2.1	SCNFRC	Scene fractions

Table E-3. Module Names (2 of 4)

MODULE NUMBER	MODULE NAME	C O M M E N T
5.3.1.2.2	COMPOS	Composite (model calculations)
5.3.1.3	INVNF	Inversion (by the) numerical filter algorithm
5.3.1.3.1	NUMFIL	Numerical filter
5.3.1.3.1.1	SVD	Singular value decomposition
5.3.1.3.1.1.1	SIASOS	Compute singular values
5.3.2	NSSPEC	Nonscanner special (data processing)
5.4	INVFIN	Inversion finalize
5.4.1	ACTCLS	Active (regions) closed
5.4.2	INVPS	Inversion (Main-Processor) processing summary
5.4.2.1	DRPDAT	Data drop start/stop times and differences
5.4.2.2	NEST	Compute 10-deg zonal averages
5.5	INVPP	Inversion Post-Processor
5.5.1	INITPP	Initialize Post-Processor
5.5.2	DATRUN	Data run
5.5.2.1	AVGRAD	Average radiometric data
5.5.3	INPPPS	Inversion Post-Processor Processing Summary
5.6	SIMNTH	Monthly product generator
5.6.1	SPECS	Reads specifications of output product
5.6.2	START	Drives processing of the S-7 or V-6
5.6.2.1	OUTHED	Generates product key for S-7 or V-6 output
5.6.2.2	DAILY	Determines which daily files are being added to output tape
5.6.2.2.1	PKCHCK	Checks that daily files meet the output specifications
5.6.2.3	SCOFF	Writes packed medium-wide data to output file
5.6.2.3.1	SOPACK	Packs medium-wide data

Table E-3. Module Names (3 of 4)

MODULE NUMBER	MODULE NAME	C O M M E N T
5.6.2.4	AEXIST	Determines if a tape already exists for product, month, year, and spacecraft
5.6.2.5	SMERGE	Reads existing S-7 tape and writes daily files
5.6.2.6	VMERGE	Reads existing V-6 tape and writes daily files
5.6.2.7	DAYSRT	Merge daily files from input tape with new daily files
5.6.3	SUMMRY	Monthly-Processor Processing Summary
5.7.1	SIPI24	Pack ID-24
5.7.2	SIPI4	Pack ID-4
D.5.1	SIDI24	Dump ID-24
D.5.2	SIDI25	Dump ID-25
D.5.3	SIDS8	Dump S-8
G.5.1	RDAT	Read data
G.5.1.1	READER	Read input-PAT record and process errors
G.5.2	NSSCN	Nonscanner scene (information)
G.5.3	REGIJ	Regional I (and) J (indices calculated)
G.5.4	HISTO	Histogram
G.5.5	QUAD	Quadrature (weights)
G.5.6	GEOSCN	Geographic scene (indices determined)
G.5.7	ANGCAL	Angle calculations
G.5.8	SCTSA	Scanner (data for) time/space averaging
G.5.9	INVSF	Inversion (by the) shape factor algorithm
G.5.9.1	SFAC1	Shape factor (calculation technique) 1
G.5.9.2	SFAC2	Shape factor (calculation technique) 2
G.5.10	NSTSA	Nonscanner (data for) time/space averaging
G.5.10.1	SCNCON	Scene (type) conversion

Table E-3. Module Names (4 of 4)

MODULE NUMBER	MODULE NAME	C O M M E N T
G.5.10.2	SCNFIL	Supplies nonscanner scene fill data to DDB when daytime SW scanner data are available
G.5.11	ABEND	Main-Processor diagnostic print routine
G.5.12	RVALUE	R value from tri-linear interpolation
G.5.13	AVALUE	A value from bi-linear interpolation
G.5.14	ABEND	Post-Processor diagnostic print routine
G.5.15	PATBUF	Copies PAT* to PAT60 when there is no or no more NS data
G.5.16	DPACK	Apply scale factors and offsets to non-default elements of a real array to prepare them for packing
G.5.17	FILWRT	Apply scale factors and offsets to PAT record and print results
G.5.18	HPACK	Transfer elements from real array to integer array
G.5.19	PARMGT	Extract parameter from execution control statement
G.5.20	PPSPEC	Print product specifications
G.5.21	PRPHED	Print external from physical header
G.5.22	RECRNG	Get range of records to dump from execution control statement
G.5.23	ID12RD	Reads daily MWDT file and copies it to output
G.5.24	ID13RD	Reads daily ETVD file and copies it to output
G.5.25	DVALUE	D value from linear interpolation

APPENDIX F

COMMON BLOCKS

Appendix F contains a comprehensive list of COMMON Blocks used in Inversion Subsystem Software (Table F-1), Subroutine/COMMON Block matrices for each Inversion Subsystem program (Tables F-2 through F-9), and COMMON Block variable definitions (Tables F-10 through F-42). If a COMMON Block is described in its entirety outside of Appendix F, Table F-1 will provide a reference to that location, rather than duplicate the description. Note that in the COMMON Block variable definition section, a variable is sometimes defined in terms of another variable. For example, variable N5 in COMMON BLock /INTERN/ is defined in terms of variable N6. In cases such as this, the notes following the table will specify the location of the definition of the variable used in the descriptive section.

Table F-1. Inversion Subsystem COMMON Block Guide

COMMON BLOCK	COMMENTS
/ACTREG/	Table F-10
/CHARCM/	See Reference 5
/CONST/	Table F-11
/CSWOFF/	Table F-12
/DIMEN/	Table A-8b
/ERROR/	Table F-13
/FILES/	Table F-14
/FLAG/	Table F-15
/FLAGS/	Table F-16
/GLOBAL/	See Reference 5
/HDBUF/	Table F-17
/HDCOM/	Table F-18
/HEADER/	Table F-19
/HIST/	Table F-20
/ID1/	Table A-6a
/ID2/	Table A-6a
/INTERN/	Table F-21
/INVCOM/	Table F-22
/IOUNIT/	Table F-23
/LIMITS/	Table A-8c
/MWDCOM/	Table F-24
/MWPACK/	Table F-25
/NADREG/	Table F-26
/NSMEAS/	Table F-27
/NSSET/	Table F-28
/PATDAT/	Table A-8d
/PATSET/	Table F-30
/PATSTF/	Table F-31
/POINT/	Table A-8e
/PRCSUM/	Table F-32
/PROCSS/	Table F-33
/QUADWT/	Table A-7
/REPORT/	Table F-34
/SHPFAC/	Table A-9
/SPECIF/	Table F-36
/SPECOR/	Table A-3
/SWOFF/	Table F-37
/SYSCOM/	Table F-38
/TSA/	Table F-39
/UNIT/	Table A-8f
/USPARM/	Table A-8g
/VALCOM/	Table F-40
/VAR/	Table F-41
/VDTOUT/	Table F-42

Table F-2. Subroutine/COMMON Block Matrix, Inversion Subsystem Main-Processor (SIMAIN) (1 of 3)

SUBROUTINE NAMES	COMMON BLOCK NAMES																														
	ACTREG	CHARCM	CONST	CSWOFF	DIMEN	ERROR	FLAG	GLOBAL	HDBUFF	HIST	ID1	ID2	INTERN	LIMITS	NADREG	NSMEAS	NSSET	PATDAT	PATSET	PATSTF	POINT	QUADWT	REPORT	SHPFAC	SPECOR	SWOFF	TSA	UNIT	USPARM	VAR	VDTOUT
ABEND	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔
ACTCLS																							✔				✔				
ANGCAL			✔																												
AVALUE											✔																				
AXTRAN																														✔	
CHRREQ						✔		✔																				✔			
COMPOS			✔								✔																				
DATNS			✔										✔			✔	✔													✔	
DRPDAT																															
DSHIFT			✔										✔			✔															
DVALUE											✔																				
ETVOUT									✔											✔		✔						✔		✔	
GEOSCN		✔				✔		✔				✔																			
HISTO	✔	✔			✔	✔		✔	✔	✔				✔													✔	✔	✔		
INFLCO		✔	✔			✔	✔	✔			✔	✔				✔						✔								✔	
INVERT	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
INVFIN									✔																			✔			
INVNF			✔											✔		✔													✔		
INVPS		✔	✔		✔		✔	✔	✔				✔	✔					✔	✔			✔					✔	✔	✔	
INVSF														✔		✔													✔		
NEST			✔																												
NSINV			✔		✔		✔						✔				✔													✔	

Table F-2. Subroutine/COMMON Block Matrix, Inversion Subsystem Main-Processor (SIMAIN) (2 of 3)

SUBROUTINE NAMES \ COMMON BLOCK NAMES	ACTREG	CHARCM	CONST	CSWOFF	DIMEN	ERROR	FLAG	GLOBAL	HDBUFF	HIST	ID1	ID2	INTERN	LIMITS	NADREG	NSMEAS	NSSET	PATDAT	PATSET	PATSTF	POINT	QUADWT	REPORT	SHPFAC	SPECOR	SWOFF	TSA	UNIT	USPARM	VAR	VDTOUT
NSREG			✔													✔													✔	✔	
NSSCN	✔	✔			✔	✔		✔			✔		✔	✔	✔								✔				✔		✔		
NSSPEC			✔				✔									✔	✔												✔	✔	
NSTSA			✔		✔	✔	✔	✔	✔						✔	✔	✔						✔	✔			✔	✔	✔	✔	
NUMFIL			✔										✔			✔															
PARINT	✔		✔		✔	✔	✔	✔	✔	✔			✔	✔	✔		✔		✔	✔					✔				✔	✔	
PATVFY						✔		✔	✔				✔						✔									✔	✔		
QUA0			✔		✔								✔									✔								✔	
RDAT					✔		✔												✔	✔	✔		✔								
RDAT1					✔	✔		✔											✔	✔	✔		✔					✔			
RDPAT			✔			✔	✔	✔					✔		✔		✔		✔	✔	✔		✔					✔		✔	
READER						✔		✔					✔					✔	✔	✔								✔	✔		
REGIJ																															
RVALUE											✔																				
SCACUM	✔	✔			✔	✔	✔	✔					✔	✔									✔						✔	✔	
SCFIN	✔				✔				✔			✔											✔				✔	✔	✔		
SCINV			✔		✔	✔	✔	✔						✔					✔		✔		✔					✔	✔	✔	
SCNCON																															
SCNFIL		✔	✔		✔	✔					✔	✔																			
SCNFRC		✔	✔			✔		✔				✔																		✔	
SCNID			✔			✔		✔			✔	✔	✔	✔											✔					✔	

Table F-2. Subroutine/COMMON Block Matrix, Inversion Subsystem Main-Processor (SIMAIN) (3 of 3)

SUBROUTINE NAMES	COMMON BLOCK NAMES																														
	ACTREG	CHARCM	CONST	CSWOFF	DIMEN	ERROR	FLAG	GLOBAL	HDBUFF	HIST	ID1	ID2	INTERN	LIMITS	NADREG	NSMEAS	NSSET	PATDAT	PATSET	PATSTF	POINT	QUADWT	REPORT	SHPFAC	SPECOR	SWOFF	TSA	UNIT	USPARM	VAR	VDTOUT
SCTOA			✔				✔							✔					✔		✔		✔						✔	✔	
SCTSA	✔								✔														✔				✔	✔	✔	✔	
SFAC1			✔													✔															
SFAC2			✔													✔						✔		✔						✔	
SPCOR			✔										✔	✔					✔		✔				✔				✔		
STRT5		✔	✔		✔	✔		✔	✔		✔	✔	✔	✔				✔			✔	✔	✔	✔	✔			✔	✔		
SVD			✔			✔		✔					✔																		
VALDAT		✔	✔		✔	✔		✔	✔																			✔	✔	✔	
XMNLW			✔								✔																				

Table F-3. Subroutine/COMMON Block Matrix, Inversion Subsystem Post-Processor (SIPOST)

SUBROUTINE NAMES	COMMON BLOCK NAMES: CHARCM	GLOBAL	HDCOM	INVCOM	MWDCOM	PRCSUM	SYSCOM	VALCOM
ABEND	✔	✔	✔	✔	✔	✔	✔	✔
AVGRAD								
DATRUN		✔	✔	✔	✔	✔	✔	✔
DPACK								
INITPP		✔	✔	✔	✔	✔	✔	✔
INPPPS	✔	✔	✔	✔		✔	✔	
INVPP	✔	✔	✔	✔	✔	✔	✔	✔
PATBUF		✔	✔	✔		✔	✔	✔

Table F-4. Subroutine/COMMON Block Matrix, Inversion Subsystem Monthly-Processor (SIMNTH)

SUBROUTINE NAMES	CHARCM	FILES	FLAGS	GLOBAL	HEADER	IOUNIT	MWPACK	PROCSS	SPECIF
AEXIST			✔	✔	✔	✔		✔	
DAILY		✔	✔		✔			✔	
DAYSRT			✔			✔		✔	
ID12RD									
ID13RD									
OUTHED				✔	✔	✔		✔	
PKCHCK					✔			✔	
SCOFF				✔		✔	✔		
SIMNTH	✔	✔	✔	✔	✔	✔	✔	✔	✔
SMERGE			✔			✔	✔	✔	
SOPACK							✔		
SPECS				✔				✔	✔
START			✔					✔	✔
SUMMRY	✔			✔	✔	✔		✔	
VMERGE			✔			✔		✔	

(Column group heading: COMMON BLOCK NAMES)

Table F-5. Subroutine/COMMON Block Matrix, ID-24 Packing Program (SIPI24)

SUBROUTINE NAMES	COMMON BLOCK NAMES: CHARCM	GLOBAL
DPACK		
HPACK		
PARMGT		
PPSPEC	✔	
PRPHED	✔	✔
SIPI24	✔	✔

Table F-6. Subroutine/COMMON Block Matrix, ID-4 Packing Program (SIPI4)

SUBROUTINE NAMES	COMMON BLOCK NAMES: CHARCM	GLOBAL
DPACK		
HPACK		
PARMGT		
PPSPEC	✔	
SIPI4	✔	✔

Table F-7. Subroutine/COMMON Block Matrix, ID-24 Dump Program (SIDI24)

SUBROUTINE NAMES	COMMON BLOCK NAMES: CHARCM	GLOBAL
PARMGT		
PPSPEC	✔	
RECRNG		✔
SIDI24	✔	✔

Table F-8. Subroutine/COMMON Block Matrix, ID-25 Dump Program (SIDI25)

SUBROUTINE NAMES	COMMON BLOCK NAMES: CHARCM	GLOBAL
FILWRT		
PARMGT		
PPSPEC	✔	
RECRNG		✔
SIDI25	✔	✔

Table F-9. Subroutine/COMMON Block Matrix, S-8 Dump Program (SIDS8)

	COMMON BLOCK NAMES																														
SUBROUTINE NAMES	CHARCM	GLOBAL																													
FILWRT																															
PARMGT																															
PPSPEC	✔																														
PRPHED	✔	✔																													
RECRNG		✔																													
SIDS8	✔	✔																													

Table F-10. /ACTREG/ COMMON Block

VARIABLE	DESCRIPTION
XACT25	See Table 5.2-14.
IACT25	See Table 5.2-14.
NACT	Number of active 2.5-deg regions.
KLAST	Last active region index to be updated. Last active region to be updated is IACT25(KLAST,1).

Table F-11. /CONST/ COMMON Block

VARIABLE	DESCRIPTION
SEC16	See Table A-8a.
SEC32	See Table A-8a.
N6	See Table A-8a.
NSFOV	See Table A-8a.
IPROD	See Table A-8a.
DELSUN	See Table A-8a.
DELZEN	See Table A-8a.
DELAZ	See Table A-8a.
DELCLT	See Table A-8a.
IZEN	See Table A-8a.
IAZ	See Table A-8a.
SPIN	See Table A-8a.
RADDEG	Number of degrees in a radian.[1]
DEGRAD	Number of radians in a degree.[1]
PI	Ratio of circumference to diameter for a circle.[1]
EO	Solar constant at 1 astronomical unit (wm^{-2}).[1]
GM	Gravitational constant of earth (m^3 sec^{-2}).
RTOA	Distance from the center of the earth to the top of the atmosphere, RTOA = (TOA + RADEAR), (m).
TOA	Reference altitude from the Earth's surface to the top of the atmosphere.[1]
RADEAR	Earth's radius (m).[1]
FACALB	See Table A-8a.
FACLW	See Table A-8a.
ISPZEN	See Table A-8a.
ISPAZ	See Table A-8a.
NOTES: 1. Variables RADDEG, DEGRAD, PI, EO, TOA and RADEAR are input on NAMELIST $NAMGLB from a file of ERBE System Processing constants. See Reference 5.	

Table F-12. /CSWOFF/ COMMON Block

VARIABLE	DESCRIPTION
NITOFF	Character variable used as day/night flag while processing nighttime SW offset values.

Table F-13. /ERROR/ COMMON Block

VARIABLE	DESCRIPTION
IERR	Error message number.
ICODE	Error type returned to calling program.
NOTES:	1. This COMMON Block contains parameters used with system subroutine SYSMSG. 2. Also see Reference 5.

Table F-14. /FILES/ COMMON Block

VARIABLE	DESCRIPTION
FILNAM	Array (31) of character file names associated with the daily Medium-Wide FOV Data Tape or daily Earth Target Validation Data files.

Table F-15. /FLAG/ COMMON Block

VARIABLE	DESCRIPTION
SWFLAG	Flag controlling switching from scanner to nonscanner processing; see Table 5.2-2.
ICIRC	Flag indicating orbit type: = ‘C’, circular orbit. = ‘E’, elliptical orbit.
TOAFLG	TOA estimate flag: = ‘B’, neither the SW nor the LW estimate of the radiant exitance at the TOA is good. = ‘G’, either the SW estimate, the LW estimate, or both are good.
IFLGST	Array (0:247) containing total channel measurement flags.[2]
IFLGSS	Array (0:247) containing scanner shortwave channel measurement flags.[2]
IFLGSL	Array (0:247) containing scanner longwave channel measurement flags.[2]
IFLGWT	Array (0:19) containing WFOV total channel measurement flags.[2]
IFLGWS	Array (0:19) containing WFOV shortwave channel measurement flags.[2]
IFLGMT	Array (0:19) containing MFOV total channel measurement flags.[2]
IFLGMS	Array (0:19) containing MFOV shortwave channel measurement flags.[2]
IFLAG	Nonscanner processing mode flag. = ‘REG’, regular nonscanner processing. = ‘SP1’, special nonscanner processing, clean-up mode. = ‘SP2’, regular nonscanner processing, scene independent shape factor inversion only using function SFAC2, #G.5.9.2.
NOTES: 1. This COMMON Block contains only character type data. 2. Radiometric data/FOV flags are set to ‘G’ for good and to ‘B’ for bad.	

Table F-16. /FLAGS/ COMMON Block

VARIABLE	DESCRIPTION
IDFLAG	Array (31) indicating if a day of the month is available for the Medium-Wide FOV Data Tape or Earth Target Validation Data monthly product. IDFLAG(K) = 0 - day K not available. IDFLAG(K) = 1 - day K will be copied from an existing monthly file to the new output monthly file. IDFLAG(K) = 2 - day K data is new.
IAEFLG	Flag indicating whether a monthly tape already exists for the current product, spacecraft, and month.

Table F-17. /HDBUF/ COMMON Block

VARIABLE	DESCRIPTION
IBUF	Array (8) containing ERBE logical header for input-PAT, ID-3 or ID-24.
IBUF01	Array (8) containing ERBE logical header for Scanner output to Daily Data Base Subsystem, ID-6.
IBUF02	Array (8) containing ERBE logical header for Nonscanner output to Daily Data Base Subsystem, ID-7.
IBUF03	Array (8) containing ERBE logical header for Histogram Product, ID-8.
IBUF04	Array (8) containing ERBE logical header for daily Earth Target Validation Data, ID-13.
IBUF05	Array (8) containing ERBE logical header for PAT*, ID-20.
IBUF06	Array (8) containing ERBE logical header for Output Data to Inversion Subsystem Post-Processor, ID-21
NOTE:	Each array contains an ERBE logical header with the following format:

HEADER ARRAY ELEMENT ELEMENT NUMBER	DESCRIPTION
1	14 digit ERBE product key. The left-most digit is digit 1 and is the subsystem indicator (4 for Merge-FOV, 5 for Inversion). Digit 2-3 is the product code (02 for pre-PAT). Digit 4 is the spacecraft number (1 for NOAA 9, 2 for ERBS, and 3 for NOAA 10). Digits 5-11 is the same as IBUF(3). Digit 12 is the first digit of the initial fractional Julian date. Digits 13-14 are a processing iterative counter.
2	Spacecraft indicator.
3	Initial whole Julian date (day).
4	Initial fractional Julian date * 10**9 (day).
5	Final whole Julian date (day).
6	Final fractional Julian date * 10**9 (day).
7	Number of files on tape.
8	Number of records per file.

Table F-18. /HDCOM/ COMMON Block

VARIABLE	DESCRIPTION
ID20HD	Array (8) containing ERBE logical header for PAT*, ID-20.
ID7HDR	Array (8) containing ERBE logical header for Nonscanner output to Daily Data Base Subsystem, ID-7.
ID21HD	Array (8) containing ERBE logical header for Output Data to the Inversion Subsystem Post-Processor, ID-21
IVHDR	Array (8) containing ERBE logical header for Scanner and Nonscanner Scene Validation Data, ID-4.
I24HDR	Array (8) containing ERBE logical header for unpacked Processed Archival Tape, ID-24.
IMWHDR	Array (8) containing ERBE logical header for daily Medium-Wide FOV Data Tape, ID-12.
NOTES: 1.	For a description of the ERBE logical header, see Table F-17.

Table F-19. /HEADER/ COMMON Block

VARIABLE	DESCRIPTION
IBUFIN	Array (8) containing header for the first input Medium-Wide FOV Data Tape or Earth Target Validation Data daily file.
IOBUF	Array (8) containing header for the output Medium-Wide FOV Data Tape or Earth Target Validation Data monthly product (S-7, V-6).
NOTES:	1. See Table F-17 for a description of header contents. 2. On the monthly products S-7 and V-6, IBUF(8) is set to the number of records on the last daily file that is written to the output monthly tape.

Table F-20. /HIST/ COMMON Block

VARIABLE	DESCRIPTION
IHIST	Array (10, 13, 13) containing a collection of active histograms. The first histogram is given by IHIST(1,I,J) where I ranges from 1 to NDIM10 (13) and J ranges from 1 to NDIM11 (13). IHIST can contain up to NDIM9 (10) different histograms.[1]
NHIST	Total number of current or active histograms. NHIST ranges from 0 to NDIM9 (10).[1]
NOTES:	1. Variables NDIM9, NDIM10, and NDIM11 are described in Table A-8b. 2. Histogram option is currently disabled by setting NDIM9, NDIM10, and NDIM11 to 1, redimensioning IHIST to 1, and setting the unit number associated with the Histogram Product to 0.

Table F-21. /INTERN/ COMMON Block (1 of 2)

VARIABLE	DESCRIPTION
DELCSN	Factor used to calculate solar zenith angle bin number, LSUN. See Table 5.2-6.
DELZN	Factor used to calculate spacecraft zenith angle bin number, LZEN. See Table 5.2-5.
DELAZI	Factor used to calculate relative zenith angle bin number, LAZ. See Table 5.2-7.
ASEMAX	Semimajor axis of spacecraft orbit as determined at the beginning of the first data time frame on input-PAT (m).
ECC	Orbital eccentricity as determined at the beginning of the first data time frame on input-PAT.
NSNF	Number of nonscanner measurements required for inversion by the numerical filter algorithm based only on the degree of the numerical filter (= 2 * N6 + 1).[1]
NSMAX	Maximum number of 32-sec time intervals of nonscanner data required in the **XPATNS** array [NSMIN-NDIM1].[2,5]
NSMIN	Minimum number of 32-sec time intervals of nonscanner data required in the **XPATNS** array for nonscanner data processing (= NSNF + NSFOV).[1,5]
N5	= N6 - 1.[1]
N12	= N6 * 2.[1]
SGMXSQ	= SIGMAX * SIGMAX.[3]
ARGPER	Spacecraft argument of perigee as determined at the beginning of the first data time frame on input-PAT (radians).
FSC	True anomaly of the spacecraft as determined at the beginning of the first data time frame on input-PAT (radians).
XI	Spacecraft orbital inclination as determined at the beginning of the first data time frame on input-PAT (radians).
XLGASN	Longitude of the ascending node as determined at the beginning of the first data time frame on input-PAT (radians).
DELTIM	As defined in Subroutine RDPAT, DELTIM = TNOW - TLAST. However, if (DELTIM * 86400. .GE. SEC16 + 1.), there is a data dropout on input-PAT, in which case DELTIM is redefined as DELTIM = 16./86400 to be used in the processing summary. For comparisons against TIMLIM this 16-sec difference in values has no effect on the result.[1,3,4]

Table F-21. /INTERN/ COMMON Block (2 of 2)

VARIABLE	DESCRIPTION
DTIMNS	Similar to DELTIM above, except DTIMNS is the time difference between records containing good nonscanner data.
KEY	First 3 digits of the 14 digit ERBE product key.
TORIG	Initial time from input-PAT header.
PERIOD	Orbital period of spacecraft in seconds.
NOTES:	1. N6, NSFOV, and SEC16 are described in Table A-8a. 2. NDIM1 is described in Table A-8b. 3. SIGMAX and TIMLIM are described in Table A-8c. 4. TNOW and TLAST are described in Table F-41. 5. **XPATNS** is described in Table F-28.

Table F-22. /INVCOM/ COMMON Block (1 of 2)

VARIABLE	DESCRIPTION
INSOUT	See Table B-7.
IVOUT	See Table B-7.
I24OUT	See Table B-7.
IMWOUT	See Table B-7.
ISFOFF	See Table A-8h.
I12OUT	See Table B-7.
XERROR	See Table B-7.
NDIM3	See Table B-7.
NDIM21	See Table B-7.
NDIM22	See Table B-7.
NVPTS	See Table B-7.
NVREG	See Table B-7.
VCOLAT	See Table B-7.
VLONG	See Table B-7.
ITT	Counter of validation time periods for which PAT60 data has been written to the Scanner and Nonscanner Scene Validation Data, ID-4.
STOP	Stop time for validation time period for which PAT60 data are written to the scene validation data product.
NDIM13	See Table B-7.
NPDT5	See Table B-7.
NPDT10	See Table B-7.
NPNCLT	See Table B-7.
NPNLNG	See Table B-7.
NPFNS0	See Table B-7.
NPWFT	See Table B-7.
NPWFS	See Table B-7.

Table F-22. /INVCOM/ COMMON Block (2 of 2)

VARIABLE	DESCRIPTION
NPMFT	See Table B-7.
NPMFS	See Table B-7.
NPWFUS	See Table B-7.
NPWFUL	See Table B-7.
NPMFUS	See Table B-7.
NPMFUL	See Table B-7.
NPNFTA	See Table B-7.
NPSFTA	See Table B-7.
NPNSTE	See Table B-7.
NPSFLG	See Table B-7.

Table F-23. /IOUNIT/ COMMON Block

VARIABLE	DESCRIPTION
IDUNIT	Unit number of daily Medium-Wide FOV Data Tape (ID-12) or daily Earth Target Validation Data (ID-13).
IGLOB	Unit number for ERBE system constants file.
INMNTH	Unit number for the Medium-Wide FOV Data Tape or Earth Target Validation Data tape (S-7, V-6).
IOMNTH	Unit number for the input (previously existing) S-7 or V-6 tape.
IPS	Unit number for Monthly-Processor processing summary report.
IRUNIT	Unit number for files, derived from the input S-7 or V-6, that are being replaced by new data.
IUNPP	Unit number of processing and control parameters.

Table F-24. /MWDCOM/ COMMON Block

VARIABLE	DESCRIPTION
NWDS7	See Table A-8h.
MRECFR	See Table A-8h.
MNWD	See Table A-8h.
MFWA	See Table A-8h.
MNWD60	See Table A-8h.
MWRADT	See Table A-8h.
MWRADS	See Table A-8h.
MMRADT	See Table A-8h.
MMRADS	See Table A-8h.
MWUNFS	See Table A-8h.
MWUNFL	See Table A-8h.
MMUNFS	See Table A-8h.
MMUNFL	See Table A-8h.
MWTOAN	See Table A-8h.
MWTOAS	See Table A-8h.
MFOVLT	See Table A-8h.
MFOVLG	See Table A-8h.
MOPSWD	See Table A-8h.
MWDPCK	Array (480) containing 20 packed Medium-Wide FOV Data Tape data records.

Table F-25. /MWPACK/ COMMON Block

VARIABLE	DESCRIPTION
ISFOFF	See Table A-8h.
IOUTDT	Array (1500) containing unpacked integer values for a Medium-Wide FOV Data Tape data block (20 records per block).
IPACK	Array (24) used for packed scale factors or offsets.
NWDS7	See Table A-8h.
MFWA	See Table A-8h.
MNWD	See Table A-8h.
MNWD60	See Table A-8h.
MRECFR	See Table A-8h.
MWDPCK	Array (480) containing 20 packed Medium-Wide FOV Data Tape data records.
XERROR	Inversion Subsystem default value (= 2^{15} - 1).
XMWDT	Array (75) of Medium-Wide FOV Data Tape data values for one record.
XMWOFF	Array (75) of offsets to be applied to integer Medium-Wide FOV Data Tape data.
XMWSF	Array (75) of scale factors to be applied to integer Medium-Wide FOV Data Tape data using the following formula: XMWDT(I) = REAL(IOUTDT(I))/XMWSF(I) - XMWOFF(I)

Table F-26. /NADREG/ COMMON Block

VARIABLE	DESCRIPTION
NNAD5	Number of 5-deg nadir regions opened.
NLST5	Last 5-deg nadir region observed during nonscanner processing. This region becomes the first 5-deg nadir region for the next pass through nonscanner processing.
XNAD5	Array (70,25) where XNAD5(I,J) is defined as follows: for 5-deg nadir region I ($1 \leq I \leq$ NDIM7) and J = 1-12, **XNAD5** contains the sum of the average 2.5-deg regional scene fractions; for J = 13-24, **XNAD5** contains the sum of the products of the individual average 2.5-deg regional scene fractions and the associated average albedos.[1,2]
INAD5	Array (70) where INAD5(I) is defined as follows: for 5-deg nadir region I, **INAD5** gives the one-dimensional 5-deg region number.
NNAD10	Number of 10-deg nadir regions opened.
NLST10	Last 10-deg nadir region observed during nonscanner processing. This region becomes the first 10-deg nadir region for the next pass through nonscanner processing.
XNAD10	Array (35,25) where XNAD10(I,J) is defined as follows: for 10-deg nadir region I ($1 \leq I \leq$ NDIM7) and J = 1-12, **XNAD10** contains the sum of the average 2.5-deg regional scene fractions; for J = 13-24, **XNAD10** contains the sum of the products of the individual average 2.5-deg regional scene fractions and the associated average albedos.[1,2]
INAD10	Array (35) where INAD10(I) is defined as follows: for 10-deg nadir region I, **INAD10** gives the one-dimensional 10-deg region number.
NOTES:	1. Scene type information is ordered in the **XNAD5** and **XNAD10** arrays. 2. NDIM7 and NDIM17 are described in Table A-8b.

Table F-27. /NSMEAS/ COMMON Block

VARIABLE	DESCRIPTION
CDOO	Array (-6:6) where CDOO(KMEAS) is the composite directional model value for the KMEASth nonscanner measurement.[1,5]
CSUNOO	Array (-6:6) where CSUNOO(KMEAS) is the cosine of the solar zenith angle for the KMEASth nonscanner measurement.[1,5]
XMEAS	Array (4,-6:6) where XMEAS(INS<KMEAS) is the KMEASth nonscanner measurement for the data type INS.[1,3,5]
BMATRX	Array (4,-6:6,-13:13) where BMATRX(INS,KMEAS,JSTRIP) is the influence coefficient for the INSth nonscanner data type and the JSTRIPth strip of the FOV with the KMEASth nonscanner measurement at its center.[1,2,3,5]
ESTNS	Array (8) where ESTNS(IEST) is the IESTth nonscanner estimate for the KMEASth measurement.[1,4,5]

NOTES:
1. KMEAS ranges from -N6 to N6.
2. JSTRIP ranges from -NSFOV to NSFOV.
3. INS = 1, MFOV - LW
2, WFOV - LW
3, MFOV - SW
4, WFOV - SW
4. IEST = 1, SF - MFOV - LW
2, SF - WFOV - LW
3, SF - MFOV - SW
4, SF - WFOV - SW
5, NF - MFOV - LW
6, NF - WFOV - LW
7, NF - MFOV - SW
8, NF - WFOV - SW
5. N6 and NSFOV are described in Table A-8a; KMEAS is described in Table F-41.

Table F-28. /NSSET/ COMMON Block

VARIABLE	DESCRIPTION
XPATNS	Array (100,18) containing nonscanner data summed over two data time frames.[1]
XNSDAT	Array (18) containing nonscanner data summed over one data time frame.[1]
NOTES:	1. Elements of **XPATNS** and **XNSDAT** are defined in Table F-29.

Table F-29. Content of **XPATNS** and **XNSDAT** Arrays

J	Content of **XPATNS**(I,J) and **XNSDAT**(J)[1,2]
1	Whole Julian date at beginning of second data time frame (day).
2	Fractional Julian date (day).
3	Solar constant corrected for Earth-sun distance (wm^{-2}).
4	Altitude of spacecraft above TOA at beginning of second data time frame (m).
5	Sum of WFOV shortwave measurements over the two data time frames (wm^{-2}).
6	Sum of WFOV longwave measurements (total-shortwave) over the two data time frames (wm^{-2}).
7	Sum of MFOV shortwave measurements over the two data time frames (wm^{-2}).
8	Sum of MFOV longwave measurements (total-shortwave) over the two data time frames (wm^{-2}).
9	Colatitude of spacecraft nadir at the beginning of the second data time frame. Nadir is the point where a vector from the center of the Earth to the spacecraft pierces the TOA (deg).
10	Longitude of spacecraft nadir at the beginning of the second data time frame (deg).
11	x unit position of the sun at beginning of the second data time frame in Earth equatorial-Greenwich meridian coordinate system.
12	y unit position of sun.
13	z unit position of sun.
14	Number of individual WFOV shortwave measurements summed.
15	Number of individual WFOV longwave measurements summed.
16	Number of individual MFOV shortwave measurements summed.
17	Number of individual MFOV longwave measurements summed.
18	Number of data time frames averaged. This number will be zero, one, or two.
NOTES: 1. The index I denotes 32-sec time intervals. 2. The index J denotes parameters required for each 32-sec time interval.	

Table F-30. /PATSET/ COMMON Block

VARIABLE	DESCRIPTION
XPAT	Array (3630) containing data from one PAT data time frame.[1]
DXPAT	Dummy variable used when buffering in data to XPAT.
NOTES: 1. Elements of the **XPAT** array are defined in Table A-2.	

Table F-31. /PATSTF/ COMMON Block

VARIABLE	DESCRIPTION
IPACK	Array (18) containing packed pre-PAT flags.
IUNPK	Array (252) containing unpacked pre-PAT flags.
ID3EOF	End-of-file flag for input-PAT (ID-3 or ID-24). = 0, no EOF. = 1, EOF encountered.
JRECA	Counter of read attempts made on input-PAT.
JRECG	Counter of records read successfully from input-PAT (i.e., no parity errors encountered).

Table F-32. /PRCSUM/ COMMON Block

VARIABLE	DESCRIPTION
IDAY	Day of month of current data being processed.
IMONTH	Month of current data being processed.
IYEAR	Year of current data being processed.

Table F-33. /PROCSS/ COMMON Block

VARIABLE	DESCRIPTION
IBDATE	Array (31) containing the days on the input S-7 or V-6 tape that are being replaced with new data.
IDPC	Product code for Medium-Wide FOV Data Tape or Earth Target Validation Data daily files.
IMONTH	Data month.
IMPC	Product code for S-7 or V-6 product.
INDEX	The number of days on the output S-7 or V-6 tape.
INPCNT	The number of new and replacement data days added to the S-7 or V-6 product with the current run of this software.
INPDAY	Array (31) containing the days of the month that are currently being added to the S-7 or V-6 product.
IPSARA	Array (31) of the data days on the output tape.
IPSREC	Array (31) of the number of records for each data day on the output tape.
ISCRFT	Spacecraft code for data on the current S-7 or V-6 tape.
ISKIP	The number of daily data files on the input S-7 or V-6 tape that are being replaced with new data.
IYEAR	Year for the current output S-7 or V-6 tape.

Table F-34. /REPORT/ COMMON Block (1 of 4)

VARIABLE	DESCRIPTION
ISTAT	Array (41) containing statistics for the 24-hour processing summary. Elements of ISTAT are defined in Table F-35.
XSTAT	Array (2) containing computer time and wall clock time, respectively, required by the Inversion Subsystem Main-Processor.
BLKOUT	Array (5,6) containing dropout start/stop information for up to 5 data dropout periods; for the I^{th} data dropout period, BLKOUT(I,J) is defined according to the following values of J: 1 - Time (Julian fraction), start. 2 - Colatitude, start. 3 - Longitude, start. 4 - Time (Julian fraction), stop. 5 - Colatitude, stop. 6 - Longitude, stop.
IGSW	Array (18) of good shortwave daytime scanner samples as a function of colatitude.
IGLW	Array (18) of good longwave scanner samples as a function of colatitude.
IGTOT	Array (18) of good total scanner samples as a function of colatitude.
IGTOTN	Array (18) of good total nighttime scanner samples as a function of colatitude.
IGSAMP	Array (18,5) of geo-scene types encountered as a function of colatitude and geo-scene type, NGEO.[2]
IMSAMP	Array (18, 12) of scene types encountered as a function of colatitude and Inversion Subsystem model number, NMODEL.[2]
IVZDAY	Array (7, 4) of percent cloudiness during daytime as a function of spacecraft zenith, KZEN, and the cloud cover index, NCC.[1,2]
IVZNIT	Array (7, 4) of percent cloudiness at nighttime as a function of spacecraft zenith, KZEN, and the cloud cover index, NCC.[1,2]
ISZEN	Array (10, 4) of percent cloudiness as a function of solar zenith, KSUN, and the cloud cover index, NCC.[1,2]
ISIG1D	Array (30) containing the number of scene identification calculations that resulted in a standard deviation value from 1 through 30 sigma. If standard deviation is greater than 30 sigma, it is counted in ISIG1D(30).

Table F-34. /REPORT/ COMMON Block (2 of 4)

VARIABLE	DESCRIPTION
ISIGMA	Array (-8:7, -7:7) containing in histogram format the number of shortwave vs. longwave standard deviations from -7 to +7 sigma. The “-8” row is for nighttime measurements.
XSCANS	Array (72) containing the sum of shortwave scanner estimates per 2.5-deg colatitudinal zone.
ISCANS	Array (72) containing the number of shortwave scanner estimates per 2.5-deg colatitudinal zone.
XSCANL	Array (72) containing the sum of longwave scanner estimates per 2.5-deg colatitudinal zone.
ISCANL	Array (72) containing the number of longwave scanner estimates per 2.5-deg colatitudinal zone.
XSCANA	Array (72) containing the sum of scanner albedos per 2.5-deg colatitudinal zone.
XWFSFS	Array (18) containing the sum of WFOV, shape factor, shortwave estimates per 10-deg colatitudinal zone.
IWFSFS	Array (18) containing the number of WFOV, shape factor, shortwave estimates per 10-deg colatitudinal zone.
XWFSFL	Array (18) containing the sum of WFOV, shape factor, longwave estimates per 10-deg colatitudinal zone.
IWFSFL	Array (18) containing the number of WFOV, shape factor, longwave estimates per 10-deg colatitudinal zone.
XWFNFS	Array (36) containing the sum of WFOV, numerical filter, shortwave estimates per 5-deg colatitudinal zone.
IWFNFS	Array (36) containing the number of WFOV, numerical filter, shortwave estimates per 5-deg colatitudinal zone.
XWFNFL	Array (36) containing the sum of WFOV, numerical filter, longwave estimates per 5-deg colatitudinal zone.
IWFNFL	Array (36) containing the number of WFOV, numerical filter, longwave estimates per 5-deg colatitudinal zone.
XMSWFS	Array (18) of the shortwave nonscanner 32-second average WFOV measurements at spacecraft altitude.
XMSWFL	Array (18) of the longwave nonscanner 32-second average WFOV measurements at spacecraft altitude.

Table F-34. /REPORT/ COMMON Block (3 of 4)

VARIABLE	DESCRIPTION
IMSWFS	Array (18) containing the number of shortwave nonscanner 32-second average WFOV measurements at spacecraft altitude.
IMSWFL	Array (18) containing the number of longwave nonscanner 32-second average WFOV measurements at spacecraft altitude.
XMFSFS	Array (18) containing the number of MFOV, shape factor, shortwave estimates per 10-deg colatitudinal zone.
IMFSFS	Array (18) containing the number of MFOV, shape factor, shortwave estimates per 10-deg colatitudinal zone.
XMFSFL	Array (18) containing the number of MFOV, shape factor, longwave estimates per 10-deg colatitudinal zone.
IMFSFL	Array (18) containing the number of MFOV, shape factor, longwave estimates per 10-deg colatitudinal zone.
XMFNFS	Array (36) containing the sum of MFOV, numerical filter, shortwave estimates per 5-deg colatitudinal zone.
IMFNFS	Array (36) containing the number of MFOV, numerical filter, shortwave estimates per 5-deg colatitudinal zone.
XMFNFL	Array (36) containing the sum of MFOV, numerical filter, longwave estimates per 5-deg colatitudinal zone.
IMFNFL	Array (36) containing the number of MFOV, numerical filter, longwave estimates per 5-deg colatitudinal zone.
XMSMFS	Array (18) of the shortwave nonscanner 32-second average MFOV measurements at spacecraft altitude.
XMSMFL	Array (18) of the longwave nonscanner 32-second average MFOV measurements at spacecraft altitude.
IMSMFS	Array (18) containing the number of shortwave nonscanner 32-second average MFOV measurements at spacecraft altitude.
IMSMFL	Array (18) containing the number of longwave nonscanner 32-second average MFOV measurements at spacecraft altitude.
XWFSFA	Array (18) containing the sum of WFOV, shape factor, albedos per 10-deg colatitudinal zone.
XWFNFA	Array (36) containing the number of WFOV, numerical filter, albedos per 10-deg colatitudinal zone.

Table F-34. /REPORT/ COMMON Block (4 of 4)

VARIABLE	DESCRIPTION
XMFSFA	Array (18) containing the sum of MFOV, shape factor, albedos per 10-deg colatitudinal zone.
XMFNFA	Array (36) containing the number of MFOV, numerical filter, albedos per 5-deg colatitudinal zone.
PSOFF	Array (4,15) containing the NFOV, MFOV, and WFOV, SW offsets for up to 15 orbits, along with time information for when each set of offsets was calculated.
NOTES: 1. KSUN and KZEN are defined in Table F-41. 2. NGEO, NMODEL, and NCC are discussed in Section 5.2.2.1.	

Table F-35. Content of **ISTAT** Array (1 of 2)

I	CONTENT OF **ISTAT**(I)
1	Number of data dropouts.
2	Number of scanner/nonscanner switches.
3	Number of scanner scenes identified as unknown due to rejection on RMAX (see Table A-8c) or 8-sigma.
4	Number of scanner estimates rejected on minimum albedo.
5	Number of scanner estimates rejected on maximum albedo.
6	Number of longwave scanner estimates rejected on minimum radiant exitance.
7	Number of longwave scanner estimates rejected on maximum radiant exitance.
8	Number of scanner measurements rejected on maximum spacecraft zenith angle, ZENMAX (see Table A-8c).
9	Number of scanner measurements rejected on maximum bidirectional shortwave model, RMAX (see Table A-8c).
10	Number of active 2.5-deg regions opened.
11	Number of active 2.5-deg regions closed normally.
12	Number of active 2.5-deg regions closed in subroutine ACTCLS, #5.4.1.
13	Maximum number of active 2.5-deg regions open at any one time.
14	Number of nadir 5-deg regions opened.
15	Number of nadir 5-deg regions closed normally.
16	Number of nadir 5-deg regions closed.
17	Maximum number of nadir 5-deg regions open at any one time.
18	Number of nadir 10-deg regions opened.
19	Number of nadir 10-deg regions closed normally.
20	Number of nadir 10-deg regions closed.
21	Maximum number of nadir 10-deg regions open at any one time.
22	Number of histogram regions opened.

Table F-35. Content of **ISTAT** Array (2 of 2)

I	CONTENT OF **ISTAT**(I)
23	Number of histogram regions closed normally.
24	Number of histogram regions closed in subroutine ACTCLS, #5.4.1.
25	Maximum number of histogram regions open at any one time.
26	Number of bad shortwave daytime samples.
27	Number of bad longwave samples.
28	Number of bad total samples.
29	Number of bad record level scanner flags encountered.
30	Number of bad record level nonscanner flags encountered.
31	Counter for scanner measurements that exceed SIGMAX (see Table A-8c).
32	Number of occurrences when SW NFOV offset was not calculated due to insufficient data (see subroutine SWZERO).
33	Number of occurrences when SW MFOV offset was not calculated due to insufficient data (see subroutine SWZERO).
34	Number of occurrences when SW WFOV offset was not calculated due to insufficient data (see subroutine SWZERO).
35	Number of occurrences where the calculated NFOV offset exceeded upper limit (see subroutine SWZERO).
36	Number of occurrences where the calculated MFOV offset exceeded upper limit (see subroutine SWZERO).
37	Number of occurrences where the calculated WFOV offset exceeded upper limit (see subroutine SWZERO).
38	Number of nighttime to nighttime data dropouts (see subroutine SWZERO).
39	Number of daytime to daytime data dropouts (see subroutine SWZERO).
40	Number of nighttime to daytime data dropouts (see subroutine SWZERO).
41	Number of scanner measurements rejected in subroutine SPCOR on 3 channel edit check (see COMMON Block /LIMITS/).

Table F-36. /SPECIF/ COMMON Block

VARIABLE	DESCRIPTION
PARMVL	Character string used to receive a parameter value declared on the execution control statement.
PARMNM	Character string used to receive a parameter name declared on the execution control statement.
PROD	Character string indicating which monthly product is currently being generated, “V6” for Earth Target Validation Data (V-6) and “S7” for the Medium-Wide FOV Data Tape (S-7).
SAT	Character value representing the satellite for the data of the current output product.

Table F-37. /SWOFF/ COMMON Block

VARIABLE	DESCRIPTION
XNFOFF	Sum of individual WFOV nighttime offsets from zero.
XMFOFF	Sum of individual MFOV nighttime offsets from zero.
XWFOFF	Sum of individual WFOV nighttime offsets from zero.
NNFOFF	Counter for individual NFOV nighttime offsets.
NMFOFF	Counter for individual MFOV nighttime offsets.
NWFOFF	Counter for individual WFOV nighttime offsets.
DNFOFF	Average NFOV offset.
DMFOFF	Average MFOV offset.
DWFOFF	Average WFOV offset.

Table F-38. /SYSCOM/ COMMON Block

VARIABLE	DESCRIPTION
IPSOUT	See Table B-7.
INFIL1	See Table A-8h.
IOUTDT	Array (1500) for packed Medium-Wide FOV Data Tape data items.
XPAT	Array (3630) containing PAT data items.
DXPAT	Dummy variable used when buffering in a PAT* data record.
XMWDT	Array (75) containing Medium-Wide FOV Data Tape data items.
XMWSF	Array (75) containing Medium-Wide FOV Data Tape scale factors.
XMWOFF	Array (75) containing Medium-Wide FOV Data Tape offsets.
XNS2D	Array (620) containing nonscanner to DDB data items.

Table F-39. /TSA/ COMMON Block

VARIABLE	DESCRIPTION
XSCTSA	See Table B-3.
XNSTSA	See Table B-4.

Table F-40. /VALCOM/ COMMON Block

VARIABLE	DESCRIPTION
VDTIM	Array (36, 4) containing Scene Validation Data Time Table. See Section B.8.

Table F-41. /VAR/ COMMON Block (1 of 2)

VARIABLE	DESCRIPTION
TSTART	Initially the time from first data time frame on input-PAT in Julian days. Subsequently, the time associated with the nonscanner data contained in row one of **XPATNS**.[1]
TNOW	Time now or time of current input-PAT record in Julian days.
TLAST	Time associated with the last data time frame in Julian days.
SOLCON	Current solar constant corrected for Earth-sun distance (wm^{-2}).
ATRAN	Array (3, 3) containing Euler transformation matrix for converting from the Earth equatorial-Greenwich meridian coordinate system to the spacecraft ground track aligned coordinate system.
KMEAS	Index number of current nonscanner measurement.
XGSUN	x unit position of the sun in groundtrack coordinate system at current nonscanner measurement.
YGSUN	y unit position.
ZGSUN	z unit position.
ALT	Altitude of spacecraft above TOA at current nonscanner measurement (m).
NFRST	Index specifying the first 32-sec time interval to be processed by the nonscanner.
NLAST	Index specifying the last 32-sec time interval to be processed by the nonscanner.
DELANG	Angular distance traveled by the spacecraft in 32-sec (radians).
KSUN	Solar zenith index used in scene identification algorithm.
KZEN	Spacecraft zenith index used in scene identification algorithm.
KAZ	Relative azimuth index used in scene identification algorithm.
KCOLAT	Colatitudinal index used in scene identification algorithm.

Table F-41. /VAR/ COMMON Block (2 of 2)

VARIABLE	DESCRIPTION
I32LST	Nonscanner measurement index corresponding to the **XPATNS** row number for the previous 32-sec time interval [1-NSMAX].[1,2]
COSDEL	Array (-19:19) containing precomputed (see subroutine QUAD, #G.5.5) cosine functions to be used in subroutine INFLCO, #5.3.1.2.
SINDEL	Array (-19:19) containing precomputed (see subroutine QUAD, #G.5.5) sine functions to be used in subroutine INFLCO, #5.3.1.2.
CSUNMX	Cosine of the maximum solar zenith at noon for scanner target point. Used in subroutine SCNID, #5.2.2.1 to make LW diurnal correction in apriori regional LW radiant exitance. Value determined in subroutine SCINV, #5.2 and set to zero if less than 0. (perpetual night.)
NOTES:	1. **XPATNS** is defined in Table F-28. 2. NSMAX is defined in Table F-21.

Table F-42. /VDTOUT/ COMMON Block

VARIABLE	DESCRIPTION
VDTIM	Array (36, 4) containing Scene Validation Data Time Table. See Section B.8.

APPENDIX G

INVERSION SUBSYSTEM GENERAL SUBROUTINES

This appendix contains narratives and supporting information regarding general subroutines and functions used throughout the Inversion Subsystem.

The following modules are described in Appendix G:

G.5.1	RDAT
G.5.1.1	READER
G.5.2	NSSCN
G.5.3	REGIJ
G.5.4	HISTO
G.5.5	QUAD
G.5.6	GEOSCN
G.5.7	ANGCAL
G.5.8	SCTSA
G.5.9	INVSF
G.5.9.1	SFAC1
G.5.9.2	SFAC2
G.5.10	NSTSA
G.5.10.1	SCNCON
G.5.10.2	SCNFIL
G.5.11	ABEND (Main-Processor)
G.5.12	RVALUE
G.5.13	AVALUE
G.5.14	ABEND (Post-Processor)
G.5.15	PATBUF
G.5.16	DPACK

G.5.17	FILWRT
G.5.18	HPACK
G.5.19	PARMGT
G.5.20	PPSPEC
G.5.21	PRPHED
G.5.22	RECRNG
G.5.23	ID12RD
G.5.24	ID13RD
G.5.25	DVALUE

G.1 SUBROUTINE RDAT (G.5.1)

Subroutine RDAT processes the appropriate elements of each input-PAT record, stored in array **XPAT**, in order to check the scanner and nonscanner FOV flags and the individual channel radiometric flags and to set associated Inversion Subsystem processing flags. COMMON Block /POINT/ contains pointers to the relevant flag words in the **XPAT** array; COMMON Block /FLAG/ contains the associated Inversion Subsystem processing flags. RDAT initializes all Inversion Subsystem processing flags to good; later, if an individual input flag is determined to be bad, the corresponding processing flag is set to bad.

Both scanner and nonscanner flag evaluation begins with a check of the record level flag. In either case, if the record level flag is bad, the checking of the associated individual measurement level flags is skipped. In both the scanner and nonscanner cases, the record level flag will again be checked (in SCINV, #5.2, for scanner, in RDPAT, #5.2.1, for nonscanner); therefore, individual channel processing flags need not be reset here based on a bad record level flag.

In the case of a good scanner record level flag, evaluation of the individual scanner FOV and radiometric flags follows. The FOV flags are first unpacked (BITFLG, #G.E.8.6.17), and each of the 248 scanner FOV flags is inspected. When any FOV flag is found to be bad, the three associated scanner processing flags are set to bad. Next, the flag values associated with radiometric total, shortwave, and longwave are unpacked (BITFLG) and evaluated. If an individual unpacked radiometric flag is bad, then the associated Inversion Subsystem processing flag is set accordingly.

In the case of a good nonscanner record level flag, the nonscanner FOV flags are next evaluated. There are two sets of FOV flags associated with nonscanner processing. The first set (XPAT(NPFNSF) and XPAT(NPFNSF = 1)) contains a single bit of information for each nonscanner FOV. These bits are a condensation of the individual MFOV FOV flags (XPAT(NPFMFV) through XPAT(NPFMFV + 19)) and the individual WFOV FOV flags (XPAT(NPFWFV) through XPAT(NPFWFV + 19)). If there are any bad nonscanner FOV flags (XPAT(NPFNSF) + XPAT(NPFNSF + 1) $\neq$ 0.), then the individual FOV flags for both WFOV and MFOV must be evaluated. If an individual FOV flag is bad ($\geq$ 5 for WFOV, $\geq$ 3 for MFOV), then the associated processing flag is set to bad; if the individual WFOV or MFOV FOV flag is good, then the associated radiometric flag is evaluated, and the processing flag set accordingly.

In the case that all nonscanner FOV flags are good (XPAT(NPFNSF + XPAT(NPFNSF + 1) = 0.), RDAT proceeds directly to unpack (BITFLG) and to inspect the nonscanner radiometric flags; if an individual radiometric flag is set to bad, then the corresponding Inversion Subsystem processing flag is set accordingly. See Figure G-1 for a flowchart of RDAT.

Further details concerning the FOV and radiometric flags can be found in Reference 9.

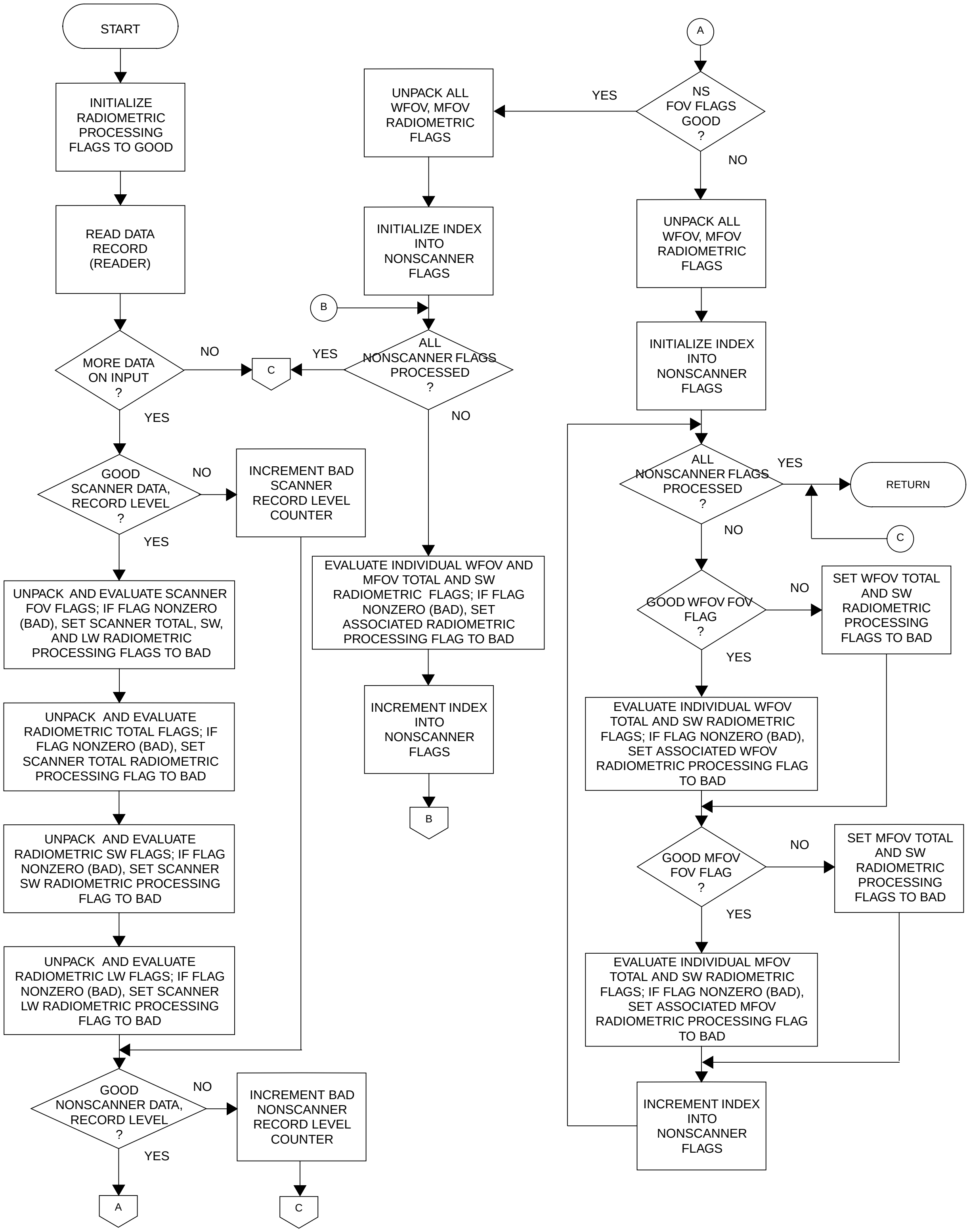


Figure G-1. Flowchart of RDAT (Module G.5.1)

G.1.1 SUBROUTINE READER (G.5.1.1)

Subroutine READER reads a single input-PAT record and performs input error processing. READER returns control to the calling routine only after a successful read is accomplished or an end-of-file (EOF) is encountered.

READER logic flow is straightforward in the case of an EOF or a successful read. In the case of an EOF, the end-of-file indicator, ID3EOF, is set to one, and control returns to the calling routine. In the case of a successful read, READER increments the counter of successful reads, JRECG. If the input is a PAT60 (restart capability), READER sets XPAT values to be supplied by the Inversion Subsystem to XERROR. Control is then returned to the calling routine.

Error handling in READER begins by checking the length of the record after the read operation. Failure to pass the length check is considered a fatal error, and subroutine SYSMSG is called to terminate processing. Additional error handling in READER is accomplished in conjunction with the use of four variables in COMMON Block /PATDAT/ (see Table A-8d). Variables JRECMN and JRECMX define the range of read attempts for which parity error processing is turned on. JMAXPE is the maximum number of parity errors allowed, JMXPLT is the maximum allowable percentage of parity errors to read attempts made. If a parity error is detected by means of the unit function, and if the read attempt is within the range defined by JRECMN and JRECMX, then error statistics are calculated. If the number of read attempts exceeds JMAXPE, or if the percentage of parity errors to read attempts exceeds JMXPLT, then SYSMSG (G.E.8.4.1) is invoked to issue an error message and terminate processing. If parity error processing is turned off, or if both the number of parity errors and percent of parity errors to read attempts are less than the specified maximums, then an attempt is made to read the next record. See Figure G-2 for a flowchart of subroutine READER.

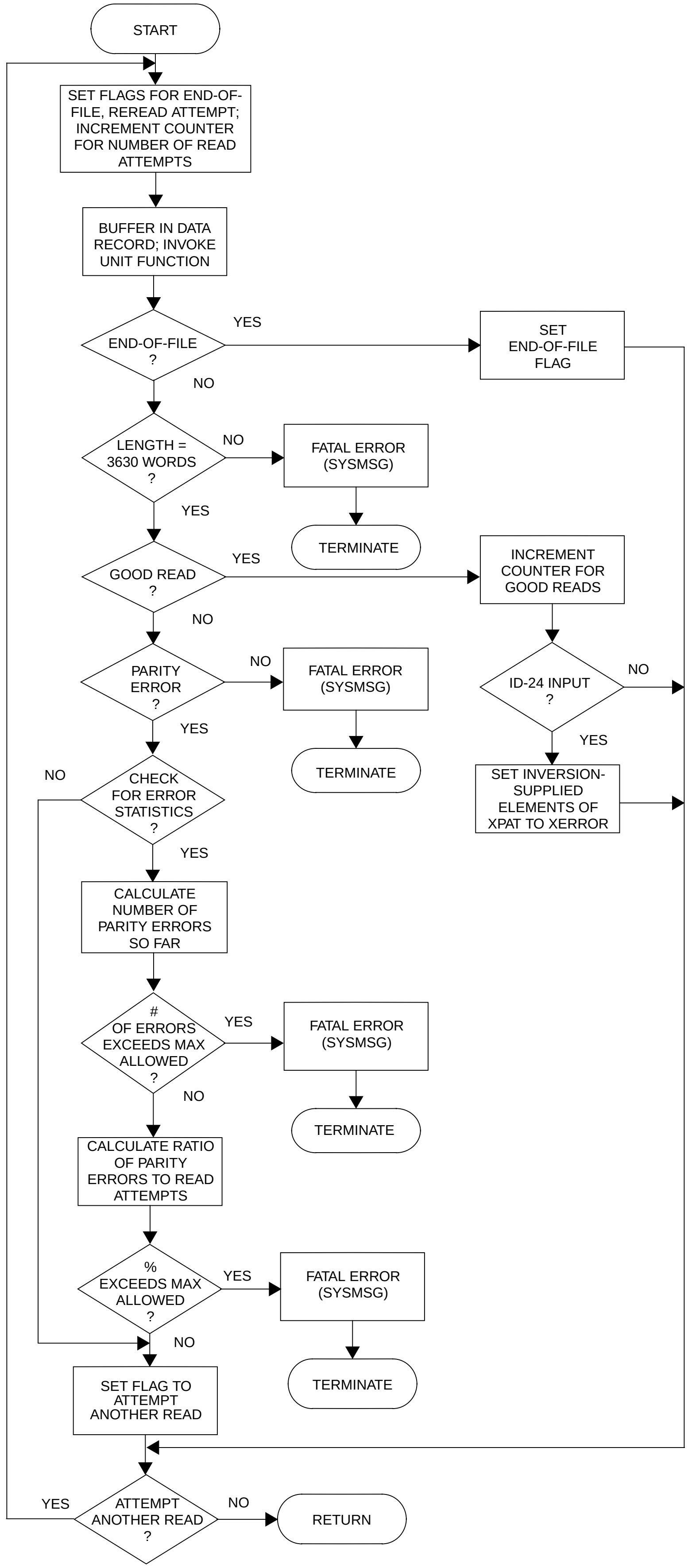


Figure G-2. Flowchart of READER (Module G.5.1.1)

G.2 SUBROUTINE NSSCN (G.5.2)

Subroutine NSSCN processes data for 5-deg and 10-deg regional scene information at nadir for the nonscanner to DDB (ID-7) output product. NSSCN can be invoked in three modes. When called with MODE = 'OPEN' (see RDPAT, #G.5.1), NSSCN initializes an active nadir region, if such a region is not yet open (see subroutine RDPAT, #5.2.1). When executed in MODE = 'SUM' (see SCFIN, #5.2.7), NSSCN sums scanner regional information. When invoked in MODE = 'FIN' (see NSINV, #5.3), NSSCN reorders the nadir region data arrays to prepare for a return to scanner processing.

The ID-7 requires certain scene information for 5-deg and 10-deg nadir regions. During scanner data processing these nadir regions are identified, and the required scene fraction and albedo data are accumulated from regional scanner output data calculated for the Daily Data Base Subsystem, such that

$$f_{NMODEL} = \sum_{i=1}^{n} \sum_{NCC=1}^{4} f'_{NCC,i}$$

and

$$a_{NMODEL} = \sum_{i=1}^{n} \sum_{NCC=1}^{4} f'_{NCC,i} \quad a'_{NCC,i} \ ,$$

where n is the number of 2.5-deg regions contained in the nadir region, such that

$$1 \leq n \leq 4, \text{ for 5-deg nadir regions,}$$

and

$$1 \leq n \leq 16, \text{ for 10-deg nadir regions.}$$

For each 2.5-deg region there is a predetermined geographic scene type, NGEO, so that for each region i,

NMODEL = MODEL(NCC, NGEO) .

Also $f'_{NCC,i}$ and $a'_{NCC,i}$ are the average scene fraction and albedo, respectively, for the ith 2.5-deg region contained in the nadir region and for cloud cover condition, NCC. See Figure G-3 for the flowchart of NSSCN.

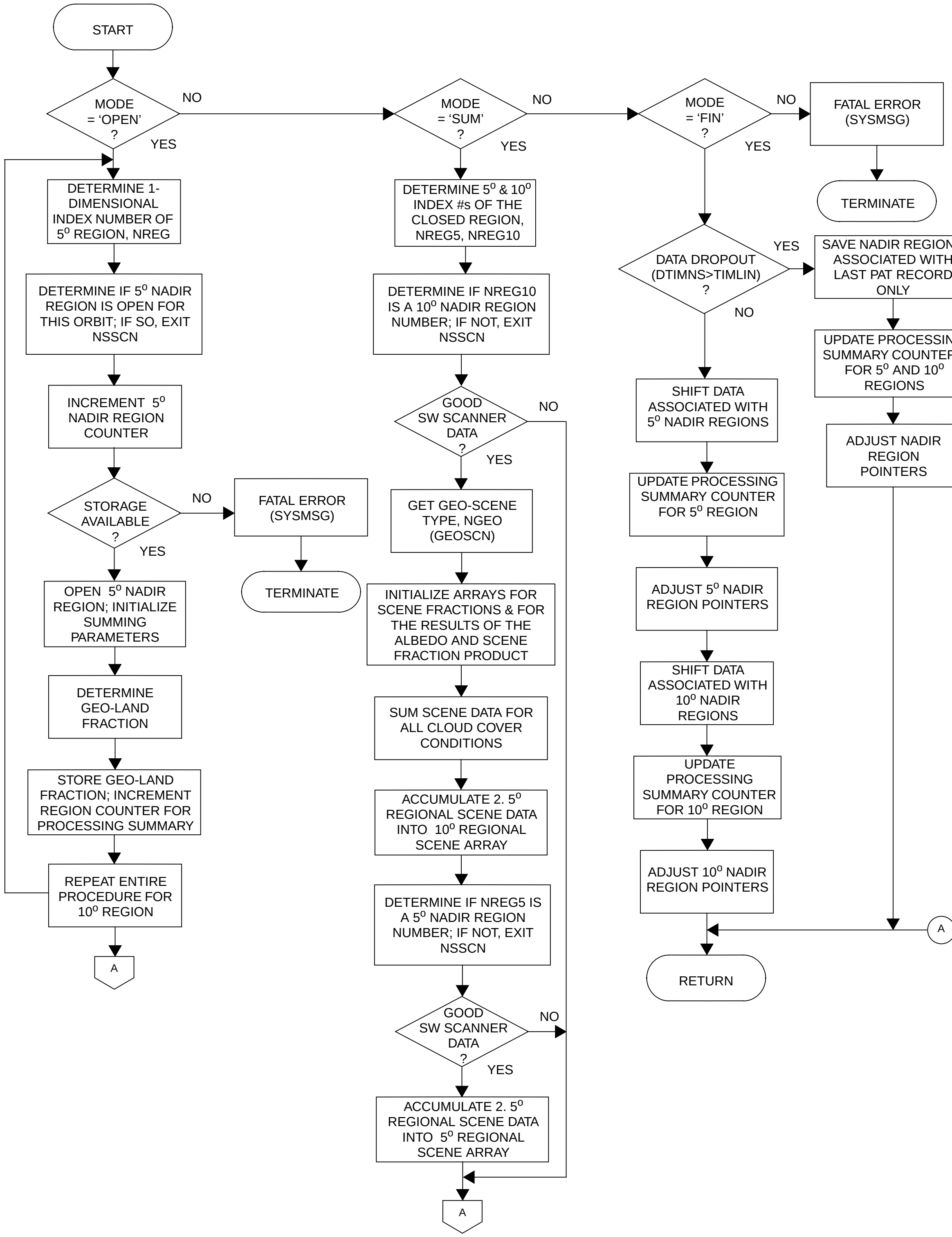
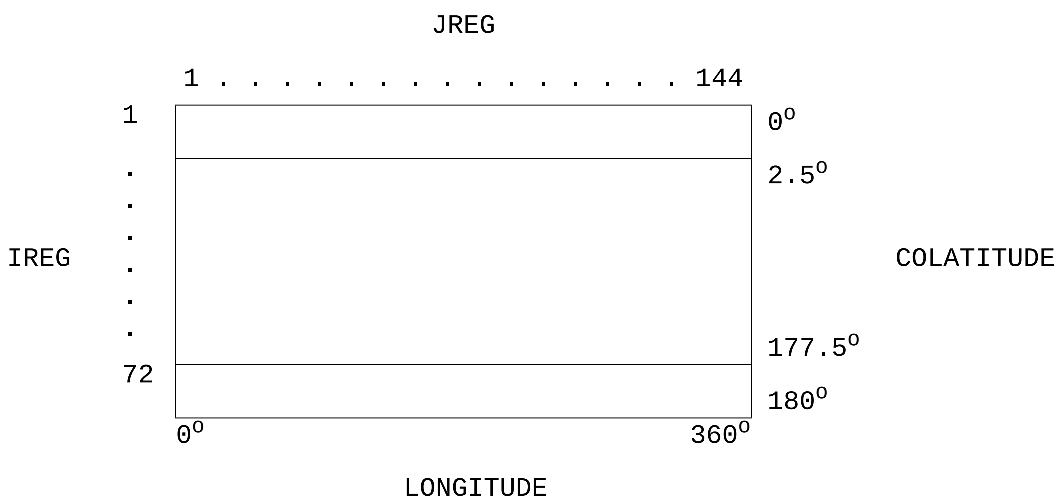


Figure G-3. Flowchart of NSSCN (Module G.5.2)

G.3 SUBROUTINE REGIJ (G.5.3)

Subroutine REGIJ is designed to calculate colatitudinal and longitudinal indices IREG and JREG based on the ERBE grid system; grid size values of 2.5-deg, 5-deg, or 10-deg regions can be specified.

The ERBE grid system for a 2.5-deg region is shown in the figure below.



In general the colatitudinal index, IREG, and the longitudinal index, JREG, can be written as

$$IREG = INTEGER\ (COLAT/XSIZE) + 1$$

and

$$JREG = INTEGER\ (LONG/XSIZE) + 1$$

where

$$XSIZE = GRDSIZ \times 1.0000001.$$

In the case of the 2.5-deg grid size, if IREG = 1 or 72, JREG is set equal to 1 so that the north pole and south pole caps will each be considered as one region rather than be divided into 144 small regions. It should be noted that this will not affect the one-dimensional region numbers, NREG, except at the poles, i.e., for IREG = 2 and JREG = 1, NREG = 145.

The one-dimensional region numbers for the 2.5-deg grid regions can be defined in terms of IREG and JREG as shown below:

$$NREG = 144 * (IREG - 1) + JREG .$$

The flowchart for subroutine REGIJ is shown in Figure G-4.

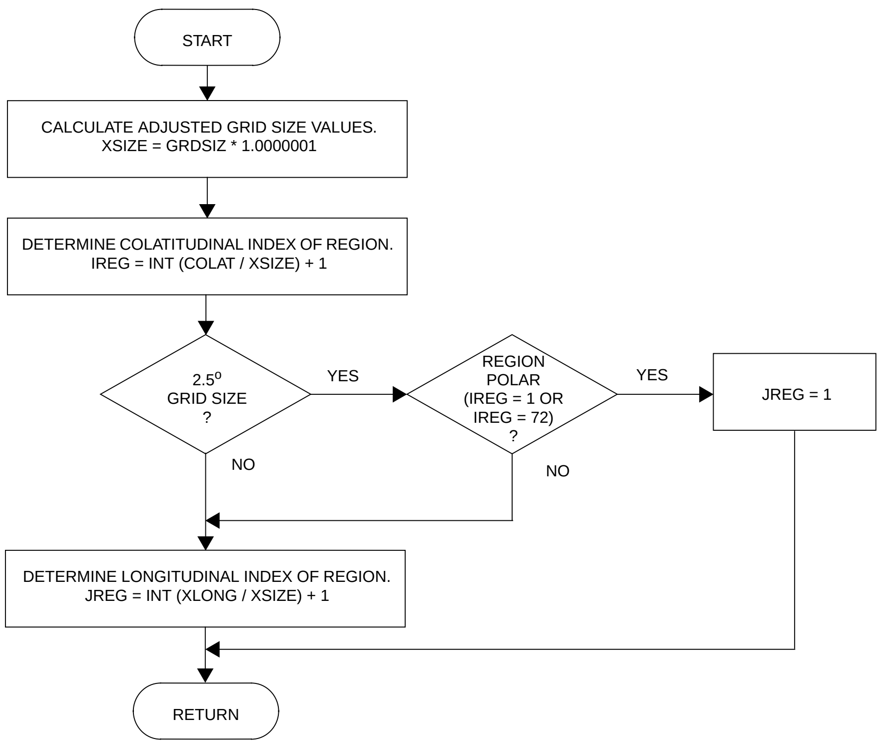


Figure G-4. Flowchart of REGIJ (Module G.5.3)

G.4 SUBROUTINE HISTO (G.5.4)

For specific 2.5-deg regions, the number of individual estimates of albedo and longwave radiant exitance at the TOA that fall into certain intervals are accumulated in histograms as illustrated in Section B.5. Histogram regions include every fourth 2.5-deg region in colatitude for IREG = 9 to 65 and every fourth 2.5-deg region in longitude for JREG = 1 to 141.

The albedo index is

$$\text{IALB} = \text{INTEGER} \left[\frac{\text{ALBEDO - HMINA}}{\text{HMAXA - HMINA}} \times (\text{NDIM11} - 1.0000) \right] + 1$$

where ALBEDO is the individual albedo estimate as calculated in subroutine SCTOA (#5.2.4), HMINA is the minimum acceptable albedo value, and HMAXA is the maximum acceptable albedo value. Any albedo value not within these acceptable limits is categorized as unknown and is accumulated with albedo index, IALB = NDIM10. HMINA and HMAXA are contained in COMMON Block /LIMITS/, and NDIM10 is from COMMON Block /DIMEN/.

The index for estimates of the longwave radiant exitance at the TOA is

$$\text{JLW} = \text{INTEGER} \left[\frac{\text{ESTLW - HMINLW}}{\text{HMAXLW - HMINLW}} \times (\text{NDIM11} - 1.00001) \right] + 1$$

where ESTLW is the individual longwave estimate as calculated in subroutine SCTOA (#5.2.4), HMINLW is the minimum acceptable longwave estimate, and HMAXLW is the maximum acceptable longwave estimate. Any longwave estimate not within these acceptable limits is categorized as unknown and is accumulated with longwave index, JLW = NDIM11. HMINLW and HMAXLW are contained in COMMON Block /LIMITS/, and NDIM11 is from COMMON Block /DIMEN/.

Histogram data are accumulated based on these indices such that

$$IHIST(IPOINT,IALB,JLW) = IHIST(IPOINT,IALB,JLW) + 1 ,$$

where the parameter IPOINT ($0 \le IPOINT \le NDIM9$) is the number of the histogram. NDIM9 is contained in COMMON Block /DIMEN/. The IPOINTth histogram is related to the active region number, K, and the one-dimensional region number, NREG, through the **IACT25** array by

$$NREG = IACT25(K,1)$$

and

$$IPOINT = IACT25(K,11) .$$

If IPOINT exceeds NDIM9, the first dimension of **IHIST**, no more histograms can be stored, and a fatal diagnostic is issued.

The indices IALB and JLW range from 1 to NDIM10 and NDIM11, respectively.

Each histogram is also associated with a particular local hour index, LHOUR, which is calculated based on the convention of the Monthly Time/Space Averaging Subsystem (see Reference 12).

Figure G-5 is a flowchart of subroutine HISTO.

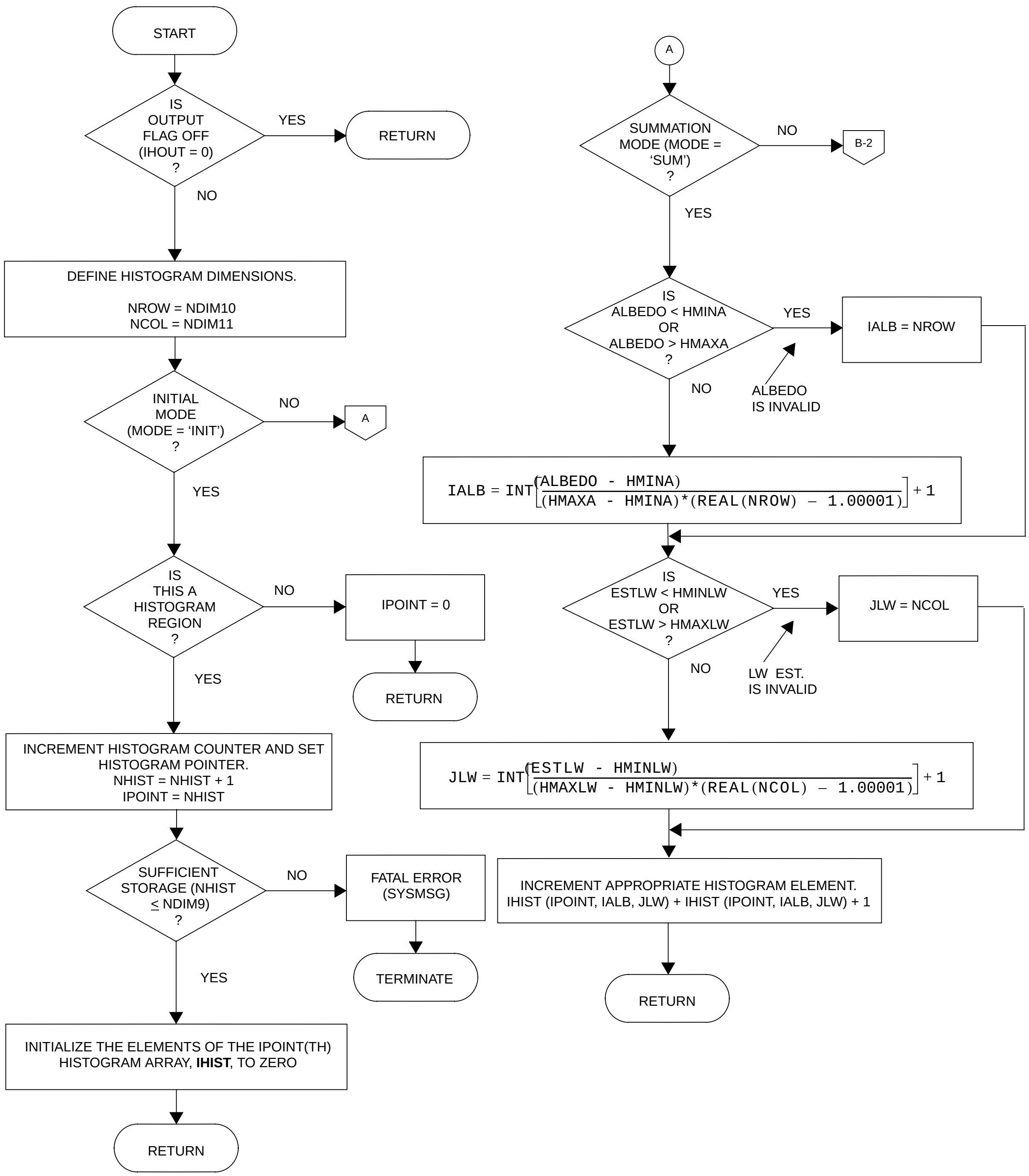


Figure G-5. Flowchart of HISTO (Module G.5.4) (1 of 2)

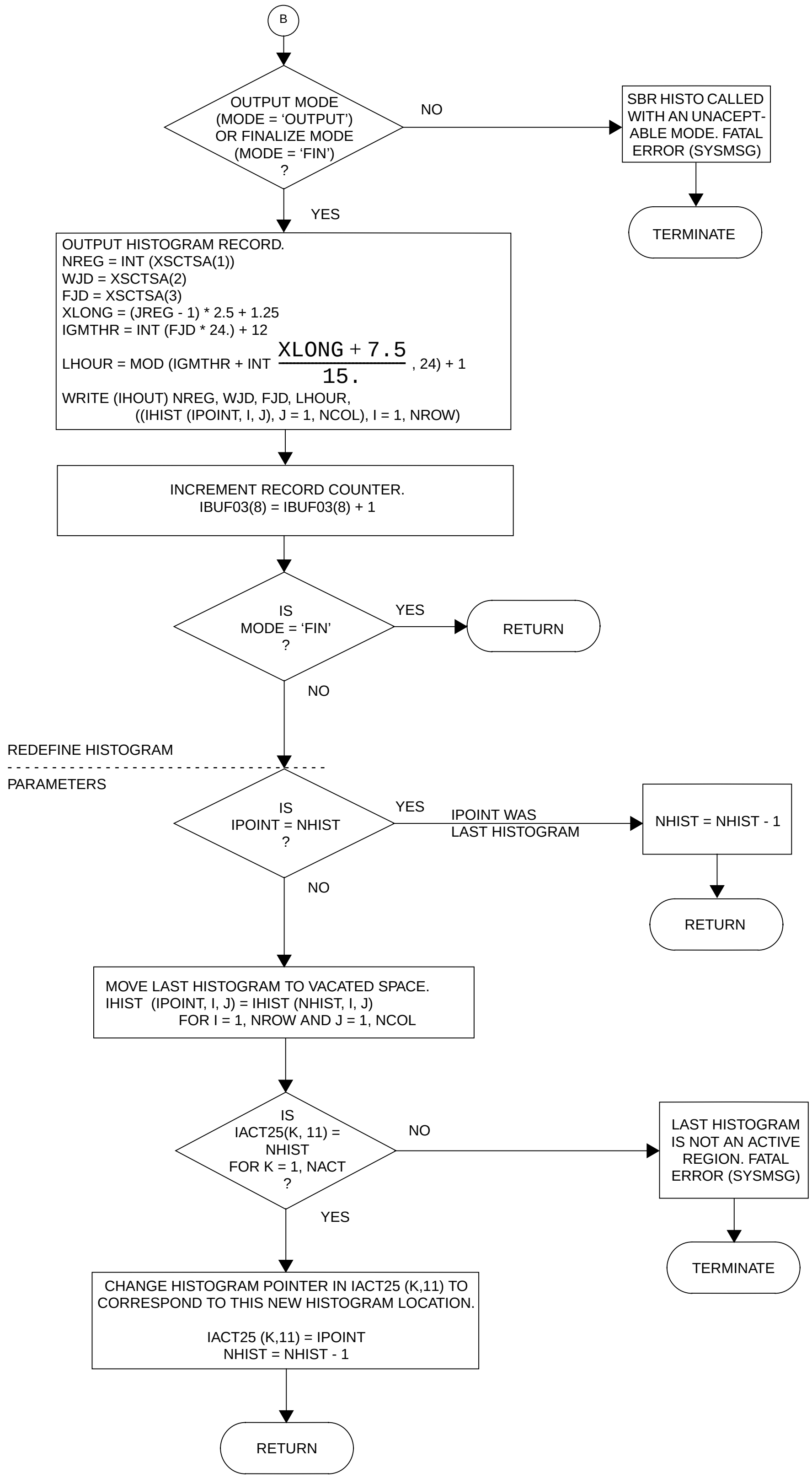


Figure G-5. Flowchart of HISTO (Module G.5.4) (2 of 2)

G.5 SUBROUTINE QUAD (G.5.5)

Subroutine QUAD determines quadrature weights (see Section A.5) required for nonscanner data inversion by performing a linear interpolation based on the altitude, h, of the spacecraft above the TOA according to

$$\gamma_{ij} = \gamma_{ij}^{min} + \frac{(\gamma_{ij}^{max} - \gamma_{ij}^{min})}{\Delta h} \quad (h - h_{min})$$

where γ_{ij}^{max} are the predetermined quadrature weights for a maximum spacecraft altitude of h_{max}, γ_{ij}^{min} are the predetermined quadrature weights for a minimum spacecraft altitude of h_{min} ,

and

$$\Delta h = h_{max} - h_{min} \quad .$$

Routine QUAD also determines the spacecraft angular velocity, calculated by

$$\dot{\theta} = \frac{[GM * a * (1 - e^2)]^{1/2}}{(r_{TOA} + h)^2}$$

where a is the semi-major axis of the spacecraft orbit, e is the eccentricity of the orbit, GM is the Earth's gravitational constant, and r_{TOA} is the distance from the Earth's center to the TOA. The angular displacement over 32 seconds is then calculated, according to

$$\Delta\theta = 32 \, \dot{\theta} \quad .$$

Once the angular displacement is determined, the sines and cosines of multiples of the angular displacement are calculated for later use when determining the influence coefficients.

Figure G-6 is a Chapin Chart showing this processing algorithm.

ENTRY

$ANGVEL = [GM * ASEMAX (1.-ECC^2)]^{1/2} / (ROTA + ALT)^2$

```
DELANG = SEC32 * ANGVEL
SINDEL(0) = 0.0
COSDEL(0) = 1.0
SINDEL(1) = SIN(DELANG)
COSDEL(1) = COS(DELANG)
FOR I = 2, NDIM14
    SINDEL(I)   = COSDEL(1) * SINDEL(I - 1)  + SINDEL(1) * COSDEL(I - 1)
    COSDEL(I) = COSDEL(1) * COSDEL(I - 1) - SINDEL(1) * SINDEL(I - 1)
FOR I = 1, NDIM14
    SINDEL(-I)   = -SINDEL(I)
    COSDEL(-I) = COSDEL(I)
RATIO = (ALT - HMIN) / (HMAX - HMIN)
FOR J = 0, NSFOV
    FOR I = 0, ILIMIT(J)
        QWFOV(I, J) = QWMIN(I, J) + (QWMAX(I, J) - QWMIN(I, J)) * RATIO
        QMFOV(I, J) = QMMIN(I, J) + (QMMAX(I, J) - QMMIN(I, J)) * RATIO
RETURN TO CALLING ROUTINE
```

Figure G-6. Chapin Chart of QUAD (Module G.5.5)

G.6 SUBROUTINE GEOSCN (G.5.6)

Subroutine GEOSCN uses the CDC ASCII collating sequence to convert the character value for the geographic scene type of a given 2.5-deg region to an integer value, NGEO. The character value for each region is stored in the scene identification matrix, DYNID(IREG,JREG,K), where K is equal to 5. Section A.4 provides a discussion of the scene identification matrices. The IREG and JREG indices for the region are passed to GEOSCN from the calling routine. The numerical value of NGEO will be associated with one of the five geographic scene types shown in Table A-5.

In the CDC ASCII collating sequence the letter A is equal to the decimal value 33, B the value of 34, and so on. Decimal values 1-32 are assigned to digits and non-alphabetical characters. The integer array **ISCTYP** consists of 26 elements, each correlated with the positions of letters in the alphabet. Using a data statement, the values of **ISCTYP** are initialized to 0 except where the position of the element correlates to a character value representing a geographic scene type (C, D, L, O, S). These elements will be assigned the numeric value of the geographic scene type. For example, the third letter of the alphabet, C, is used to represent a land/ocean mix, the fifth geo-scene type. Therefore ISCTYP(3) = 5. The second letter of the alphabet, B, is not used to represent any of the geo-scene types. Therefore ISCTYP(2) = 0. The intrinsic function, ICHAR, converts the ASCII value of the character stored in the **DYNID** array for the region to an integer. The variable, ITYPE, as calculated below, is the value of the integer returned by ICHAR, adjusted so that it can be mapped into the **ISCTYP** array.

```
ITYPE = ICHAR (DYNID(IREG,JREG,5)) - 32
```

If the value of ITYPE is between 1 and 26, the value of the associated **ISCTYP** element is assigned to NGEO, i.e.,

```
NGEO = ISCTYP(ITYPE)
```

If the value of ITYPE is invalid, or if NGEO is calculated to be 0, a fatal error exists, and SYSMSG (#G.E.8.4.1) is called to terminate processing.

Figure G-7 is a flowchart of subroutine GEOSCN.

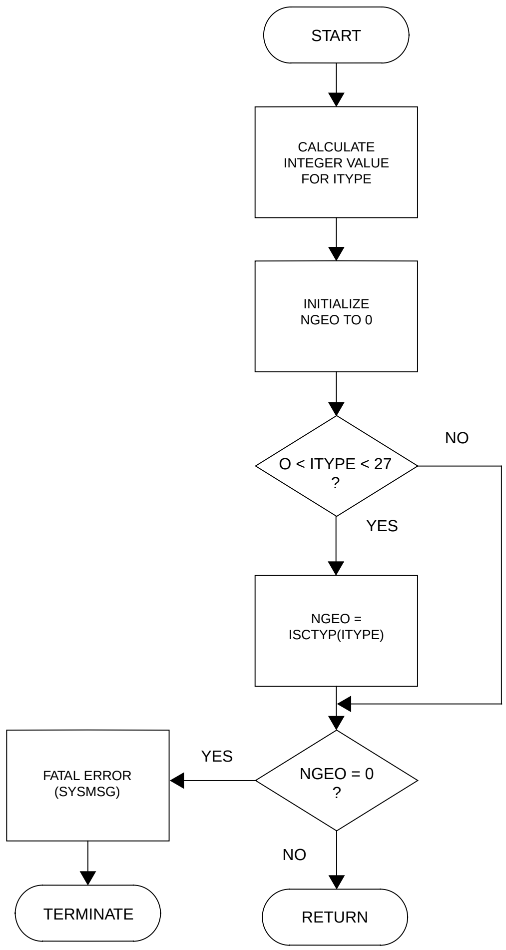


Figure G-7. Flowchart of GEOSCN (Module G.5.6)

G.7 SUBROUTINE ANGCAL (G.5.7)

Subroutine ANGCAL calculates the three directional angles for a given region. Output parameters from ANGCAL are CSUN, the cosine of the solar zenith angle, ZENSC, the spacecraft zenith angle, and AZSC, the azimuth between sun and spacecraft.

The calculation of the spacecraft zenith angle, θ'_s, the cosine of the solar zenith angle, $\cos\theta'_o$, and the relative azimuth angle, ϕ'_r, is illustrated in the following figures and text.

From Figure G-8 it can be seen that

$$\underline{r}_t \bullet \underline{r} = r_t r \cos\theta'_s$$

or

$$\cos\theta'_s = \frac{\underline{r}_t \bullet \underline{r}}{r_t r} .$$

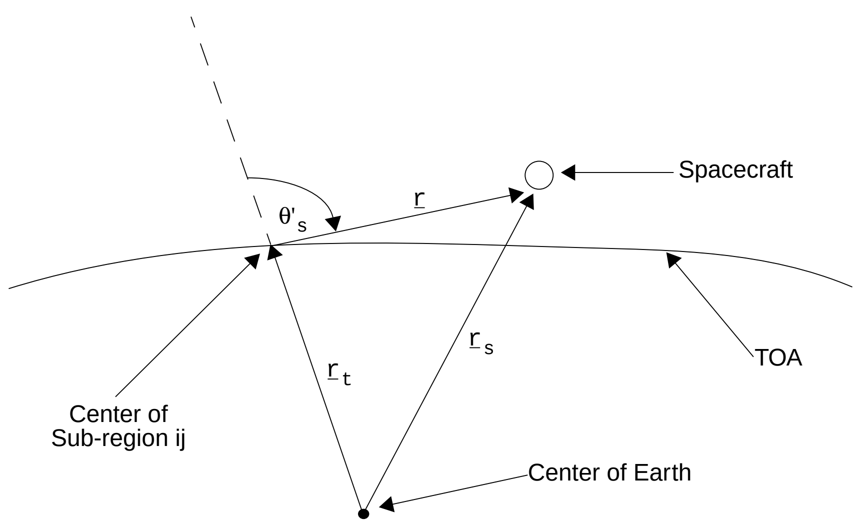


Figure G-8. Spacecraft Zenith Angle

The components of $\underline{r}$ may be written in terms of the components of $\underline{r}_s$ and $\underline{r}_t$ such that

$$x = x_s - x_t \quad ,$$
$$y = y_s - y_t \quad ,$$

and

$$z = z_s - z_t \quad .$$

Then

$$\cos\theta'_s = \frac{x_t x + y_t y + z_t z}{r_t (x^2 + y^2 + z^2)^{1/2}}$$

In terms of the components of the respective unit vectors this expression may be written as

$$\cos\theta'_s = x'_t x' + y'_t y' + z'_t z' \quad .$$

or

$$\theta'_s = \cos^{-1}(x'_t x' + y'_t y' + z'_t z') \quad .$$

Similarly,

$$\hat{r}_t \bullet \hat{r}_o = \cos\,\theta'_o \quad ,$$

or

$$\cos\,\theta'_o = x'_t x'_o + y'_t y'_o + z'_t z'_o \quad .$$

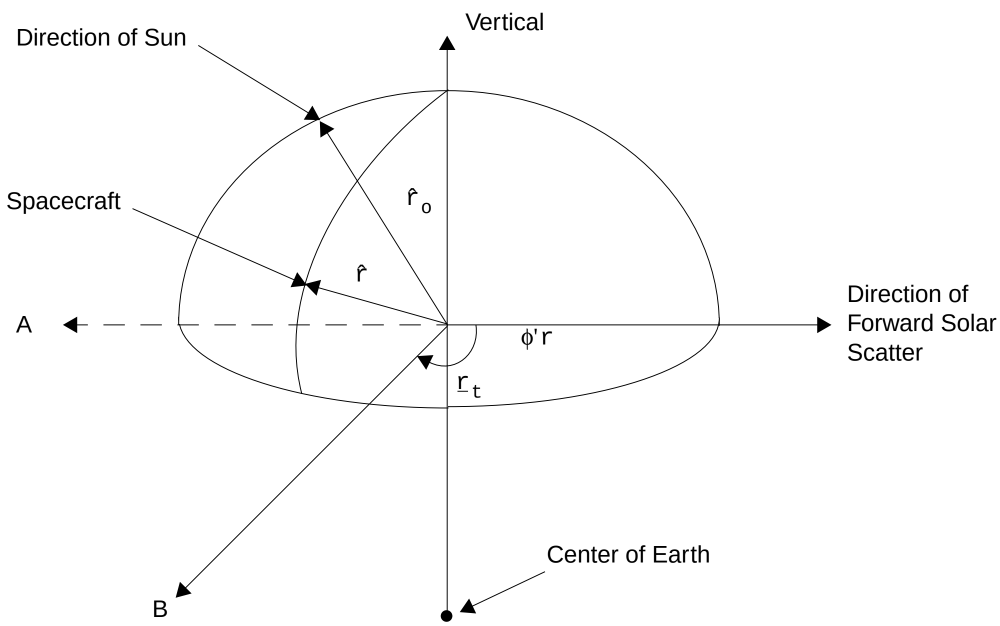


Figure G-9. Relative Azimuth Angle

The relative azimuth angle is shown in Figure G-9 above. Figure G-10 below is looking down onto the AB plane.

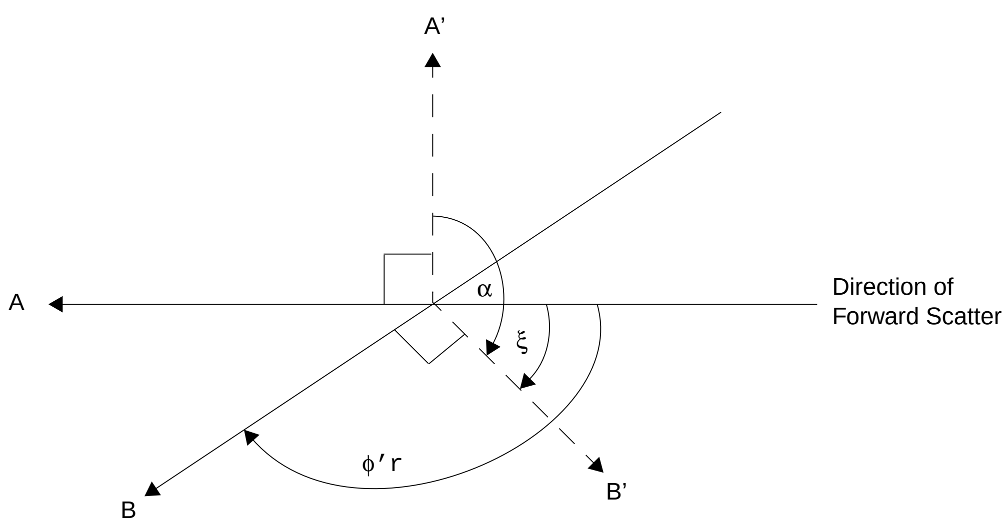


Figure G-10. Relative Azimuth Angle as Projected onto the AB Plane

From this figure it can be seen that

$$\alpha = 90° + \xi \ ,$$
$$\phi'_r = 90° + \xi \ ,$$

and, therefore,

$$\phi'_r = \alpha \ .$$

Then,

$$\underline{A}' \bullet \underline{B}' = A'B' \cos\alpha = A'B' \cos\phi'_r$$

and

$$\cos\phi'_r = \frac{\underline{A}' \bullet \underline{B}'}{\underline{A}'\underline{B}'} \ .$$

Again from the figures above,

$$\underline{A}' = \hat{r}_o \times \hat{r}_t$$

and

$$\underline{B}' = \hat{r}_t \times \hat{r} \ .$$

From these expressions, $\underline{A}'$ and $\underline{B}'$ can be written in terms of their components such that

$$A'_x = z'_t y'_o - y'_t z'_o \ ,$$

$$A'_y = x'_t z'_o - z'_t x'_o \ ,$$

$$A'_z = y'_t x'_o - x'_t y'_o \ ,$$

$$B'_x = y'_t z'_s - z'_t y'_s \ ,$$

$$B'_y = z'_t x'_s - x'_t z'_s \ ,$$

and

$$B'_z = x'_t y'_s - y'_t x'_s \ .$$

The relative azimuth can now be written as

$$\phi'_r = \cos^{-1}\left[\frac{A'_x B'_x + A'_y B'_y + A'_z B'_z}{|\underline{A}'|\ |\underline{B}'|}\right]$$

where

$$|\underline{A}'| = (A'^2_x + A'^2_y + A'^2_z)^{1/2}$$

and

$$|\underline{B}'| = (B'^2_x + B'^2_y + B'^2_z)^{1/2}$$

are the magnitudes of the $\underline{A}'$ and $\underline{B}'$ vectors, respectively.

Figure G-11 contains the flowchart of subroutine ANGCAL.

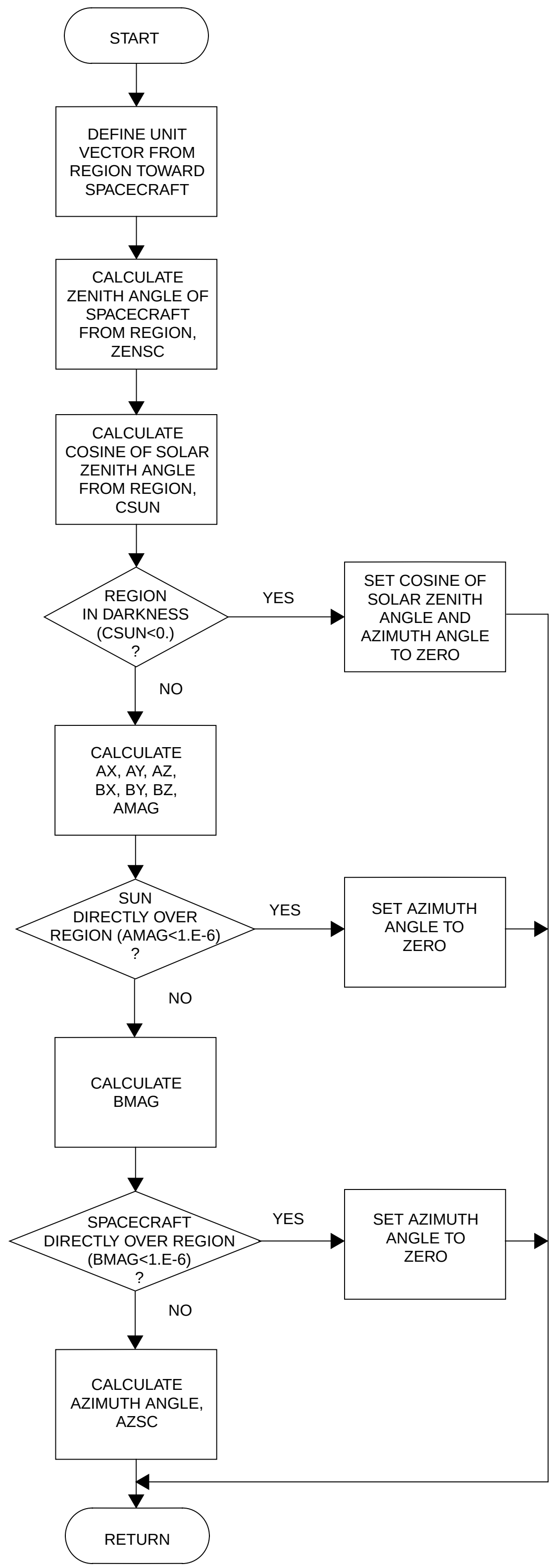


Figure G-11. Flowchart of ANGCAL (Module G.5.7)

G.8 SUBROUTINE SCTSA (G.5.8)

When an active scanner region is closed, regional scanner statistics are calculated from the accumulated data in the **IACT25** and **XACT25** arrays (see Table 5.2-14). The results are written to the Scanner output to the Daily Data Base Subsystem (scanner to DDB, ID-6) product. Table B-3 shows the content of each record on this output file.

Careful attention should be given to default values and under what conditions they are implemented as described in Section B.3 and the accompanying flowchart.

The flowchart (Figure G-12) provides a detailed reference as to the processing performed in this subroutine. Several comments concerning subroutine SCTSA processing are made below.

- Data contained in the output record as shown in the flowchart and in Table B-3 fall into four categories:

  1. Regional statistics
  2. Shortwave statistics
  3. Shortwave/Daytime statistics
  4. Longwave statistics

- Shortwave and longwave data are accumulated in this routine for the processing summary.

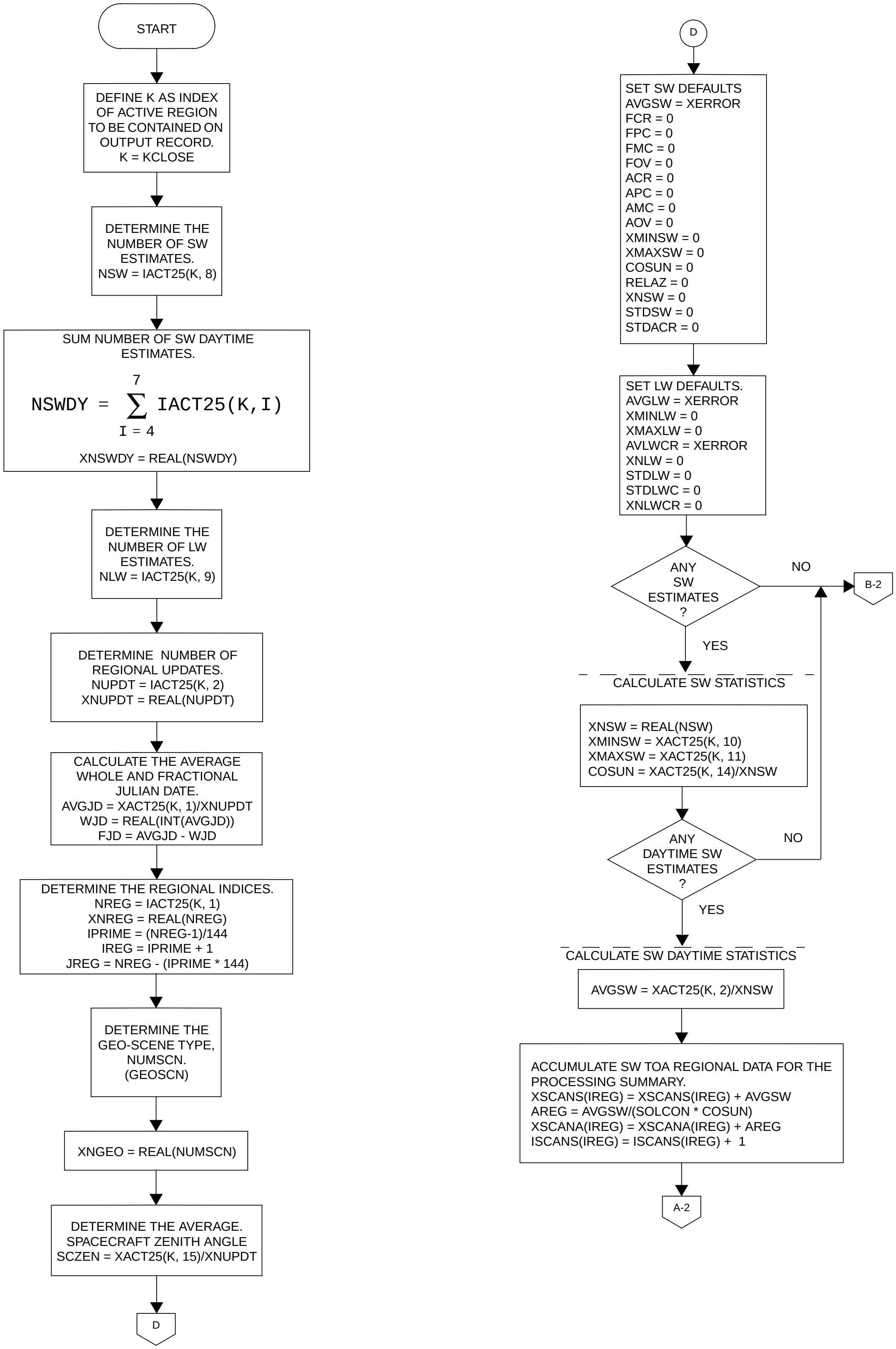


Figure G-12. Flowchart of SCTSA (Module G.5.8) (1 of 3)

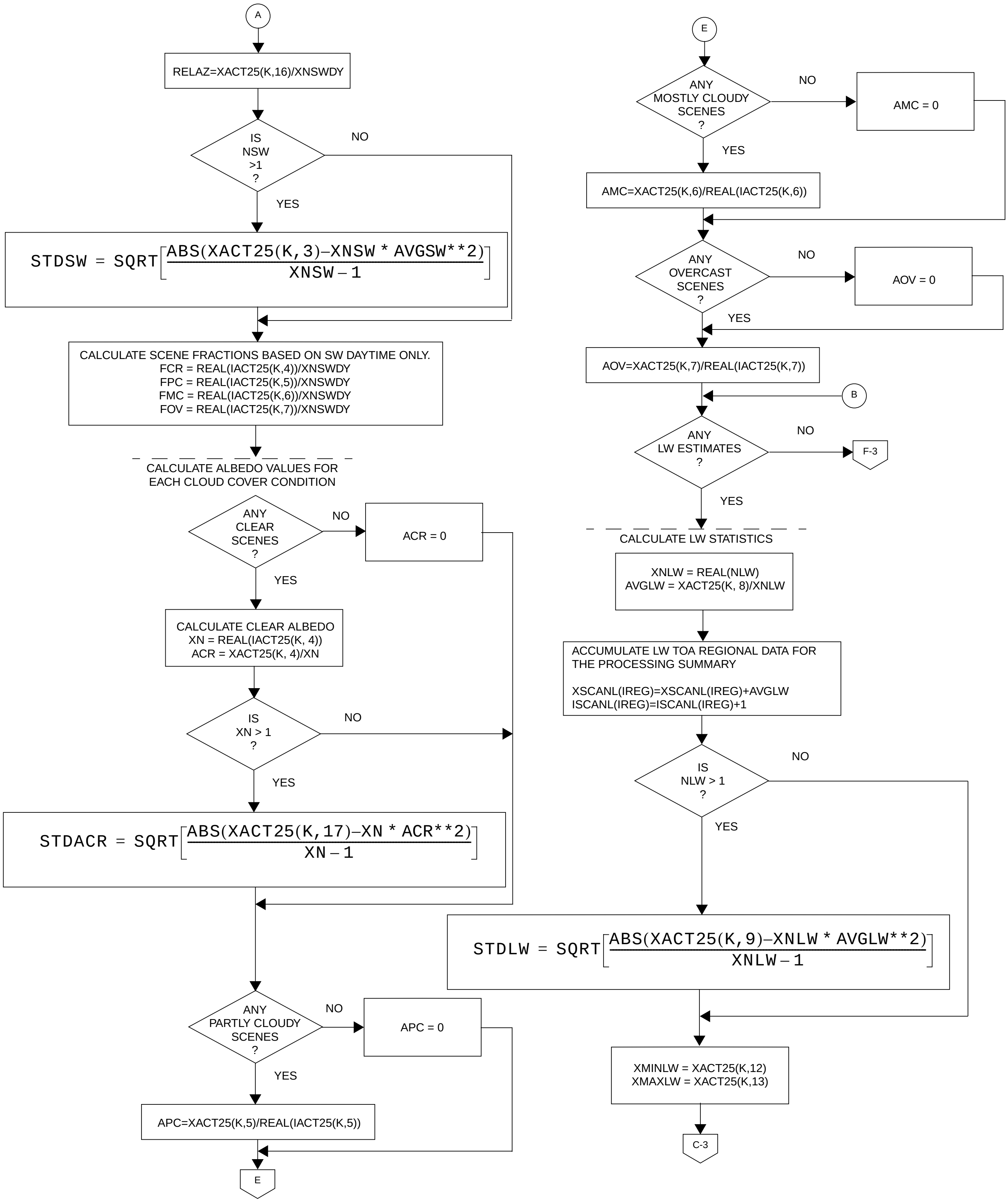


Figure G-12. Flowchart of SCTSA (Module G.5.8) (2 of 3)

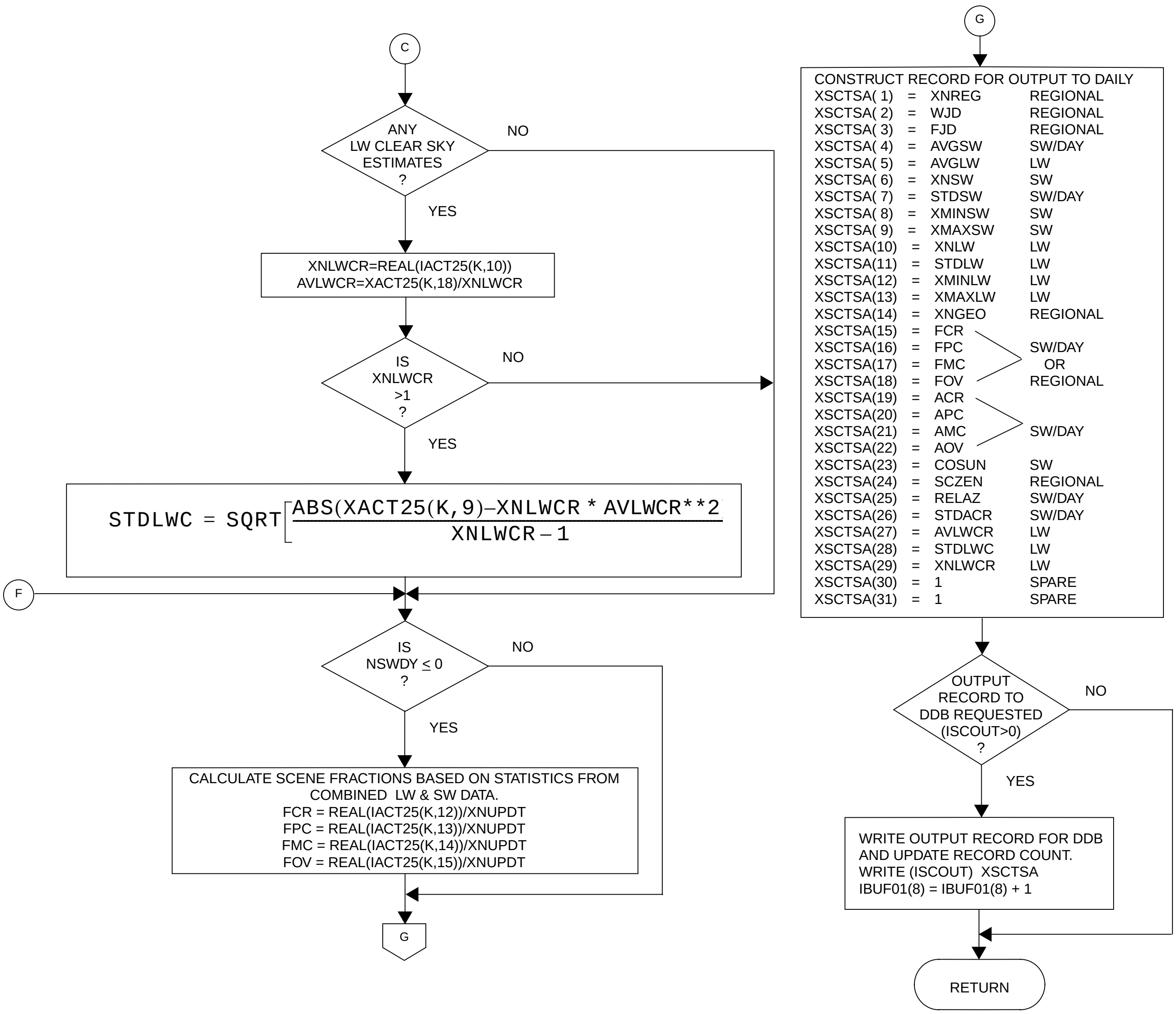


Figure G-12. Flowchart of SCTSA (Module G.5.8) (3 of 3)

G.9 SUBROUTINE INVSF (G.5.9)

Subroutine INVSF calculates the nonscanner estimates of the radiant exitance at TOA by the shape factor algorithm for longwave and shortwave measurements for both MFOV and WFOV. For each longwave measurement, the TOA value is calculated if valid measurements exist; otherwise, the corresponding TOA estimate is set to the subsystem default value. For valid daytime shortwave measurements, the TOA is calculated and stored in the appropriate elements of ESTNS; if it is nighttime, or if no valid shortwave measurement exists, the corresponding TOA estimate is set to the subsystem default value. See Figure G-13 for the flowchart of subroutine INVSF.

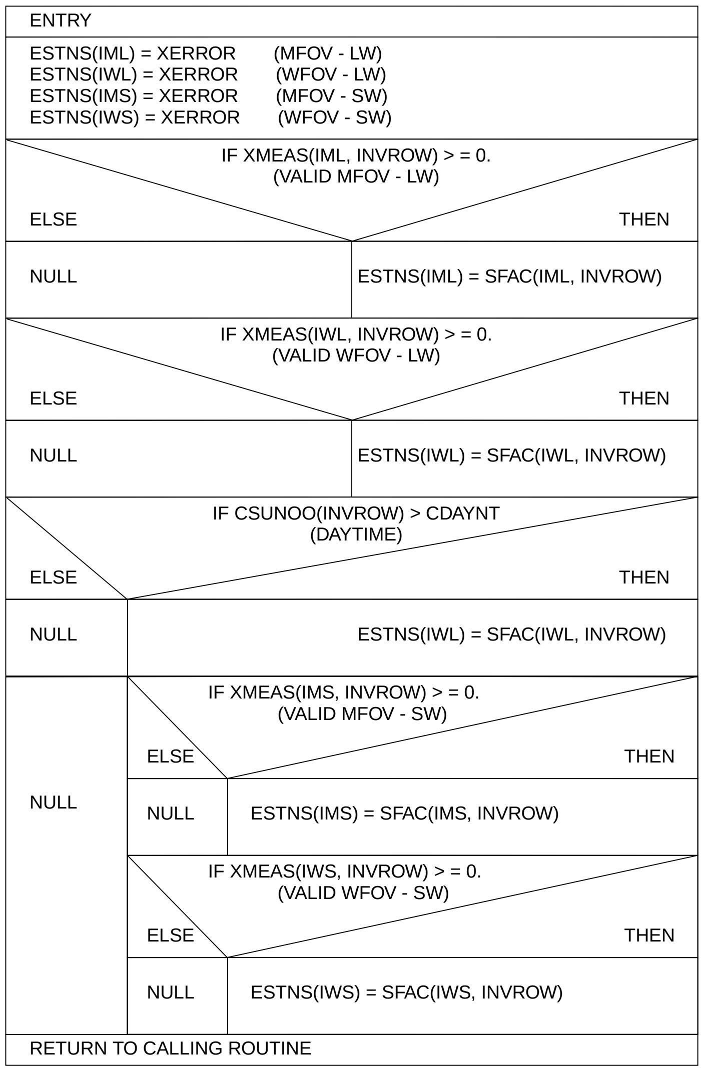


Figure G-13. Chapin Chart of INVSF (Module G.5.9)

G.9.1 FUNCTION SFAC1 (G.5.9.1)

Function SFAC1 determines a shape factor TOA estimate that is based on influence coefficients.

Influence coefficients are stored in the **BMATRX** array according to the indices INS, KMEAS, and JSTRIP (see COMMON Block /NSMEAS/). For a given measurement number, KMEAS, subroutine INVSF (#G.5.9) invokes SFAC1 once for each data type, INS. The required shape factor TOA estimate is calculated by summing over the influence coefficients such that

$$SFAC_{KMEAS}^{INS} = \sum_{JSTRIP = -NSFOV}^{NSFOV} BMATRX(INS,KMEAS,JSTRIP)$$

for INS = 1 or 2 (longwave), or

$$SFAC_{KMEAS}^{INS} = \frac{\sum_{JSTRIP = -NSFOV}^{NSFOV} BMATRX(INS,KMEAS,JSTRIP)}{CSUNOO(KMEAS) * CDOO(KMEAS)}$$

for INS = 3 or 4 (shortwave). **CSUNOO** and **CDOO** are contained in COMMON Block /NSMEAS/.

The shortwave shape factor calculation, as formulated in Reference 4, contains the corrected solar constant term, $E_o l(t)$, in the denominator. The software design omits that term here and in the calculation of shortwave influence coefficients (see Section 5.3.1.2), since they would divide out in the shape factor calculation.

The flowchart for function SFAC1 is shown in Figure G-14.

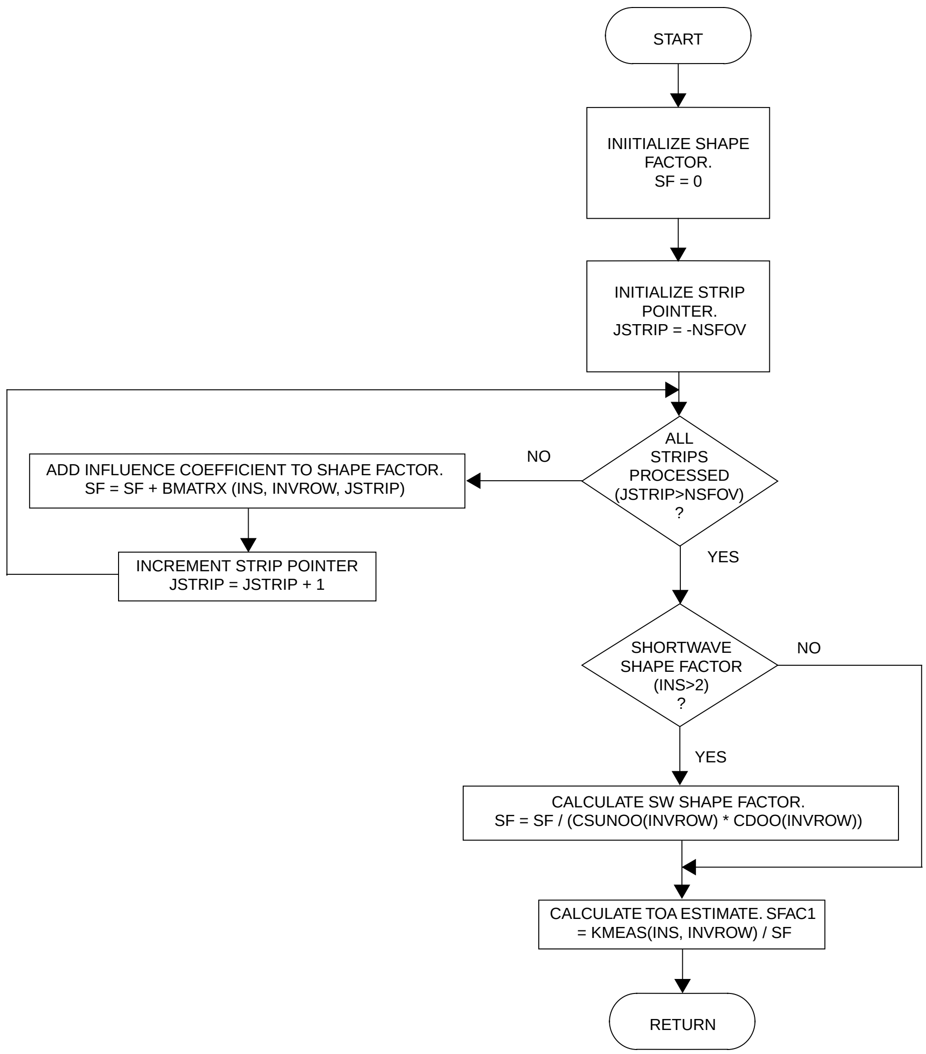


Figure G-14. Flowchart of SFAC1 (Module G.5.9.1)

G.9.2 FUNCTION SFAC2 (G.5.9.2)

Function SFAC2 determines a shape factor TOA estimate that is independent of scene type.

In the event that there are less than 13 average nonscanner measurement sets contained in the **XPATNS** array (NLAST $\leq$ 12), then influence coefficients cannot be calculated, and subroutine NSINV (see Section 5.3) requires that the special nonscanner processing mode be invoked using the scene independent shape factor algorithm (SFAC2). Function SFAC2 returns to subroutine INVSF (#G.5.9) a shape factor TOA estimate which is determined according to the following expression:

$$\mathrm{SFAC2} = \frac{\text{unfiltered}}{\text{measurement}} / \mathrm{SF} + \mathrm{B}$$

The shape factor, SF, and offset, B, are determined by interpolating input coefficients stored in COMMON Block /SHPFAC/. See Figure G-15 for the flowchart of SFAC2.

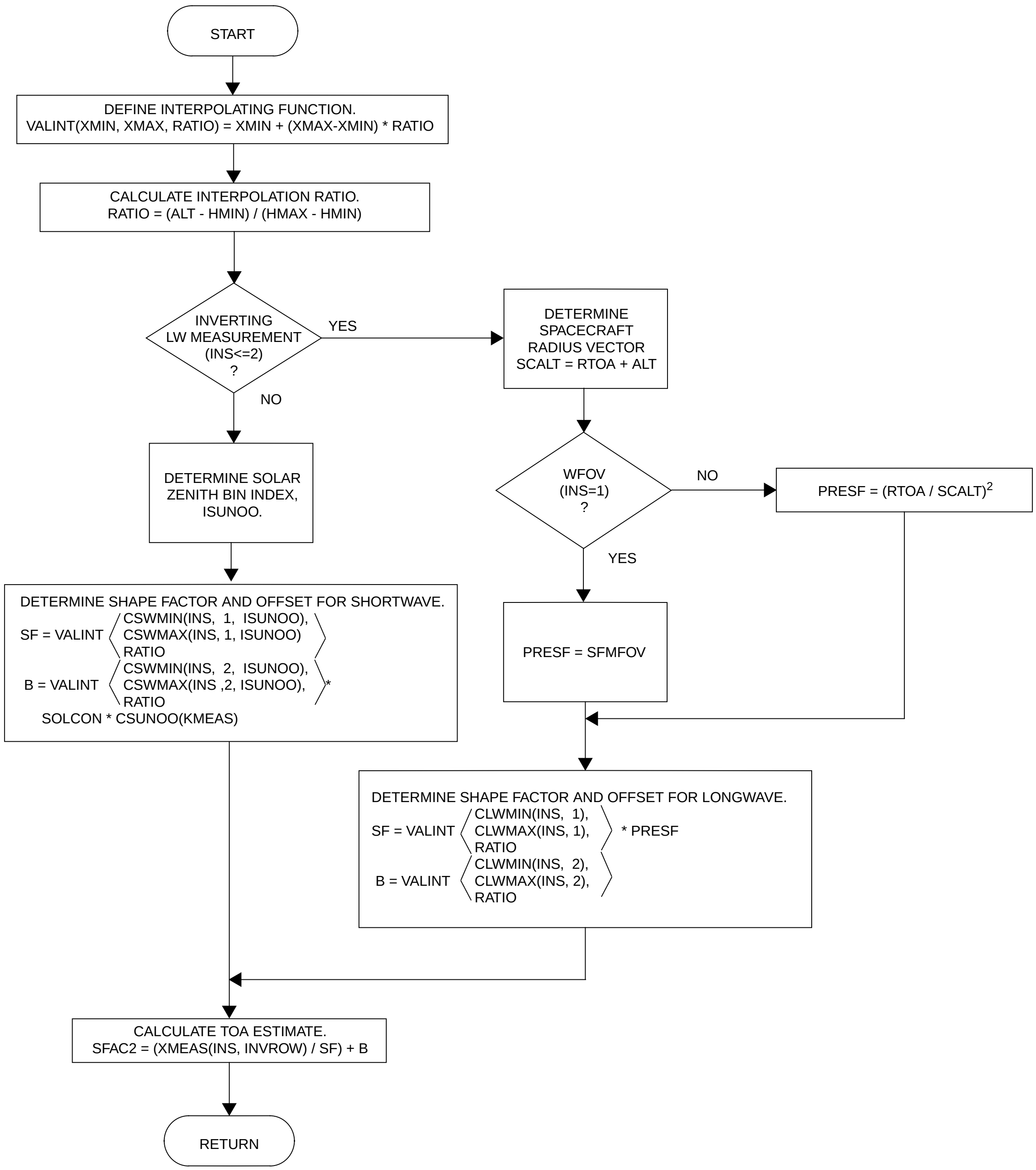


Figure G-15. Flowchart of SFAC2 (Module G.5.9.2)

G.10 SUBROUTINE NSTSA (G.5.10)

Subroutine NSTSA calculates 5-deg and 10-deg regional statistics for the Nonscanner output to Daily Data Base Subsystem (nonscanner to DDB, ID-7) product.

Following nonscanner data inversion for each 32-sec time interval, the items shown in Table B-4 must be calculated and written to a local data file. The file will be used by the Inversion Subsystem Post-Processor and subsequently will serve as the nonscanner to DDB output product.

The data required for this output file come from the **XPATNS** array (COMMON Block /NSSET/), the **ESTNS** array (COMMON Block /NSMEAS/), and the /NADREG/ COMMON Block.

Though the directional angles are not available on **XPATNS**, the information required to calculate these data using subroutines REGIJ (#G.5.3) and ANGCAL (#G.5.7) are available. From **XPATNS**, the subsatellite point is

$$\theta_s = \mathrm{XPATNS(I,9)}$$

and

$$\phi_s = \mathrm{XPATNS(I,10)} \quad .$$

The components of the unit vector of the sun are

$$x'_o = \mathrm{XPATNS(I,11)} \quad ,$$

$$y'_o = \mathrm{XPATNS(I,12} \quad ,$$

and

$$Z'_o = \mathrm{XPATNS(I,13)} \quad .$$

The spacecraft altitude above the TOA is

$$\mathrm{ALT} = \mathrm{XPATNS(I,4)} \quad .$$

The components of the spacecraft unit vector are

$$x'_s = \sin\theta_s \cos\phi_s \quad ,$$
$$y'_s = \sin\theta_s \sin\phi_s \quad ,$$

and

$$Z'_s = \cos\theta_s \quad .$$

The 5-deg or 10-deg nadir region indices, IREG and JREG, can be found from subroutine REGIJ (θ_s , ϕ_s , GRDSIZ, IREG, JREG) where GRDSIZ = 5.0 or 10.0.

The components of the unit vector $\hat{r}_c$ (GRDSIZ) to the center of the nadir region are

$$x'_c = \sin\theta_c \cos\phi_c \quad ,$$
$$y'_c = \sin\theta_c \sin\phi_c \quad ,$$

and

$$Z'_c = \cos\theta_c \quad ,$$

where

$$\theta_c = \left(\mathrm{IREG} - \frac{1}{2}\right) \times \mathrm{GRDSIZ}$$

and

$$\phi_c = \left(\mathrm{JREG} - \frac{1}{2}\right) \times \mathrm{GRDSIZ} \quad .$$

At this point the subroutine ANGCAL (x'_s , y'_s , z'_s , x'_o , y'_o , z'_o , x'_c , y'_c , z'_c , ALT, CSUN, ZENSC, AZSC) can be invoked to calculate the directional angles CSUN, ZENSC, and AZSC.

The calculation of regional scene fractions and albedos is described below. Scene information is accumulated for 5-deg and 10-deg nadir regions in subroutine NSSCN (#G.5.2) such that for NCC = 1 through 4

$$NMODEL = MODEL(NCC,NGEO),$$

$$f_{NMODEL} = \sum_{i=1}^{n} f'_{NCC,i} ,$$

and

$$a_{NMODEL} = \sum_{i=1}^{n} f'_{NCC,i} \times a'_{NCC,i} ,$$

where

$$1 \leq n \leq 4, \text{ for 5-deg nadir regions,}$$

and

$$1 \leq n \leq 16, \text{ for 10-deg nadir regions.}$$

The Daily Data Base Subsystem requires scene fractions and albedos for a slightly different set of scene types. These nine scene types are contained in Table B-4 along with the corresponding scene data. Subroutine SCNCON (#G.5.10.1) determines values of f_{NMOD} and a_{NMOD}, for NMOD = 1 through 9, from f_{NMODEL} and a_{NMODEL}.

The average regional scene fractions are given by

$$\bar{f}_{NMOD} = f_{NMOD} /SUM$$

where

$$SUM = \sum_{NMOD=1}^{9} f_{NMOD} .$$

The average albedos are

$$\bar{a}_{NMOD} = \frac{a_{NMOD}}{f_{NMOD}} .$$

The effective regional albedo is

$$a_{eff} = \sum_{NMOD=1}^{9} \bar{f}_{NMOD} \times \bar{a}_{NMOD} \quad ,$$

and the normalized regional albedo becomes

$$a_{NMOD}^{NORM} = \bar{a}_{NMOD} / a_{eff} \quad ,$$

for NMOD = 1 through 9.

In addition to generating the nonscanner data output product, NSTSA accumulates shortwave and longwave TOA data for the processing summary.

The flowchart for subroutine NSTSA is shown in Figure G-16.

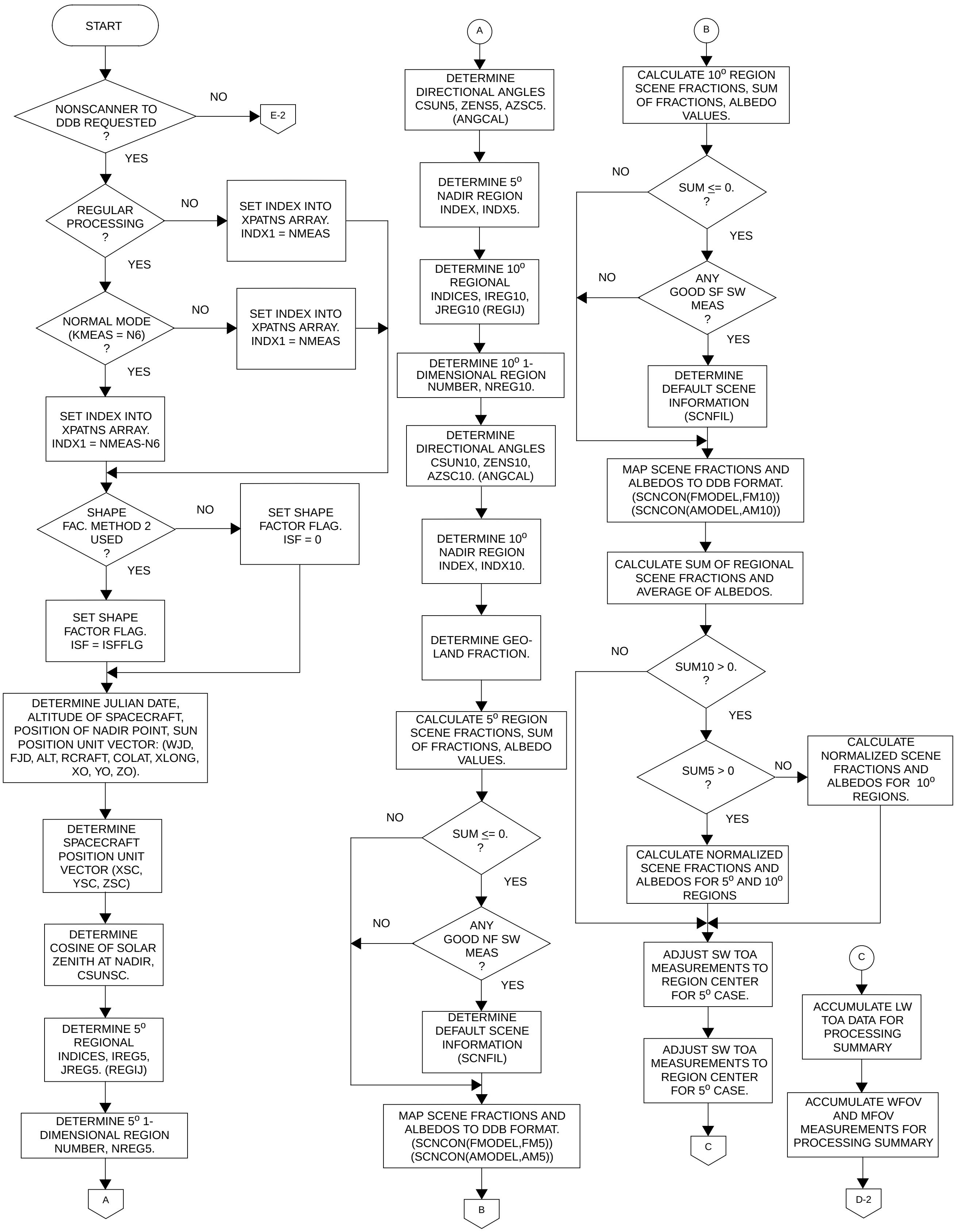


Figure G-16. Flowchart of NSTSA (Module G.5.10) (1 of 2)

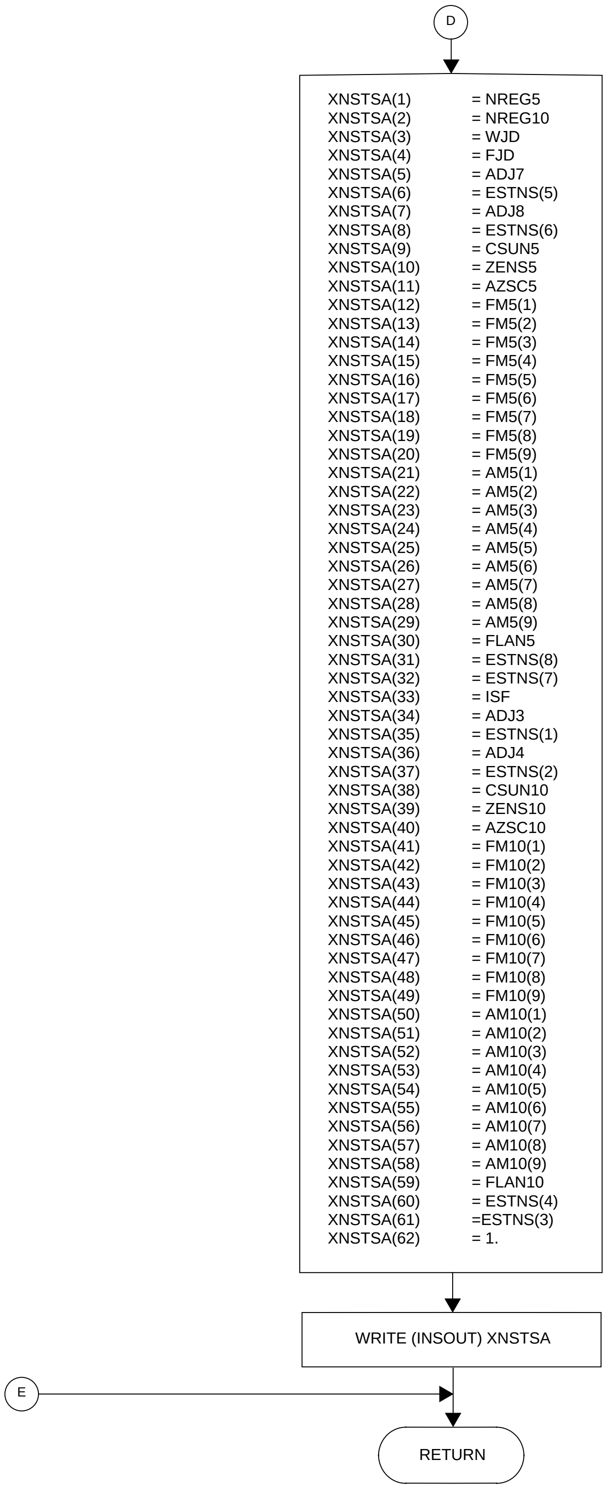


Figure G-16. Flowchart of NSTSA (Module G.5.10) (2 of 2)

G.10.1 SUBROUTINE SCNCON (G.5.10.1)

Routine SCNCON converts scene data corresponding to the 12 Inversion Subsystem scene types to the nine scene types as required by the Daily Data Base Subsystem (DDB).

The nine scene types required by the Daily Data Base Subsystem are shown in Table B-4 along with the corresponding scene data. The 12 scene types utilized by the Inversion Subsystem are shown in Table A-4. The conversion equations giving the nine DDB scene types in terms of the 12 Inversion Subsystem scene types can be seen in the Chapin chart of subroutine SCNCON, Figure G-17.

ENTRY
SDDB(1) = SINV(1) + .5 * SINV(5)
SDDB(2) = SINV(2) + .5 * SINV(5)
SDDB(3) = SINV(3)
SDDB(4) = SINV(4)
SDDB(5) = SINV(6) + .5 * SINV(8)
SDDB(6) = SINV(7) + .5 * SINV(8)
SDDB(7) = SINV(9) + .5 * SINV(11)
SDDB(8) = SINV(10) + .5 * SINV(11)
SDDB(9) = SINV(12)
RETURN TO CALLING ROUTINE

Figure G-17. Chapin Chart for SCNCON (Module G.5.10.1)

G.10.2 SUBROUTINE SCNFIL (G.5.10.2)

Subroutine SCNFIL determines default values for scene fractions and albedos for the nonscanner to DDB output product. This routine is invoked by subroutine NSTSA (#G.5.10) only if there is no shortwave scanner data to provide the necessary scene information. Input parameters to subroutine SCNFIL are IDIM, the dimension of the 5-deg or 10-deg nadir region in terms of 2.5-deg regions, IREG, the 5-deg or 10-deg colatitudinal index, JREG, the 5-deg or 10-deg longitudinal index, and CSUNSC, the cosine of the solar zenith angle at nadir. Based on the values of IDIM, IREG, and JREG, SCNFIL determines the 2.5-deg regions that make up the larger region. Then, for each 2.5-deg region, the geographic scene type is determined (GEOSCN, #G.5.6), the cloud cover fractions are calculated, the Inversion Subsystem scene type, NMODEL, is determined, and the associated scene fractions and albedos are accumulated in arrays FMODEL and AMODEL, respectively. See Figure G-18 for the flowchart of routine SCNFIL.

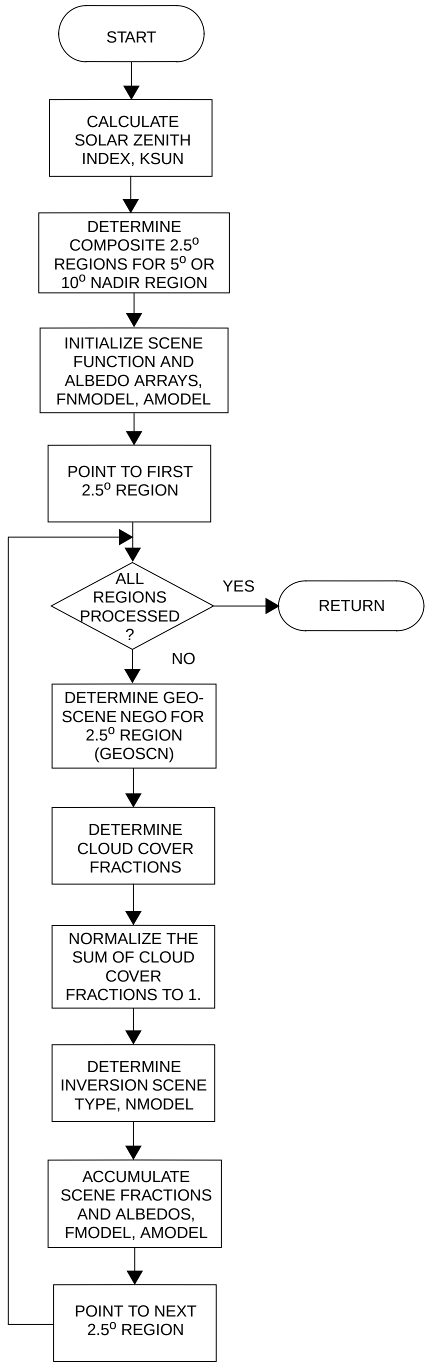


Figure G-18. Flowchart of SCNFIL (Module G.5.10.2)

G.11 SUBROUTINE ABEND (G.5.11)

In the event that a fatal error is encountered during processing of SIMAIN, subroutine ABEND is called to dump the value of each parameter in every COMMON block used by the Main-Processor. The information is written to TAPE6. Parameter values are displayed in the same order as they appear in their associated COMMON block. The COMMON blocks are displayed in alphabetical order.

A message indicating the abnormal termination of the Main-Processor is written to the ERBE Diagnostic message file, TAPE95, as well as to TAPE6. ABEND also calls subroutine INVPS (#5.4.2) to generate the processing summary report, QC-7.

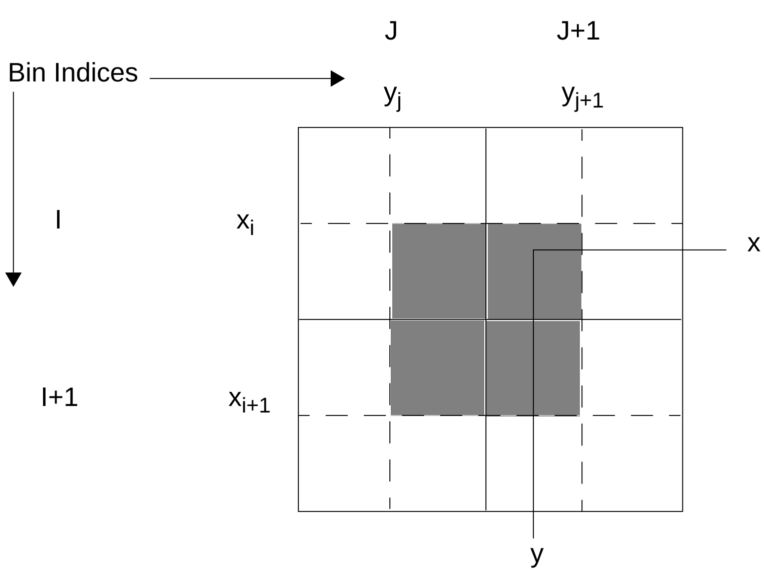
G.12 SUBROUTINE RVALUE (G.5.12)

Subroutines RVALUE and AVALUE (also see Section G.13) use a linear interpolation scheme to calculate a weighted mean for shortwave and longwave model values.

To illustrate the technique, consider the matrix **A** which contains discrete values for a continuous function of x and y such that A(I,J) = f(x_i,y_i), ie. the value of f(x,y) at (x_i,y_i) is contained in A(I,J) and taken to be at its center.

The objective of this technique is to remove the discrete nature of the data retrieved from the **A** matrix. Note that for any point, (x,y), contained in the shaded area illustrated below, the appropriate value of the function, A(x,y), is a weighted function of the four elements shown.

Illustration of Four Elements
from **A** Matrix



The interpolated value at (x,y) is

$$A(x,y) = [(1-\omega_i)A(I,J) + \omega_i A(I+1,J)](1-\omega_j) + [(1-\omega_i)A(I,J+1) + \omega_i A(I+1,J+1)]\omega_j$$

where

$$\omega_i = \frac{x - x_i}{x_{i+1} - x_i}$$

and

$$\omega_j = \frac{y - y_j}{y_{j+1} - y_j}$$

are the weighting functions or fractional intrusions into the shaded area between center points along the x and y axes, respectively.

In addition, since the area under the interpolated curve is different than the area of the discrete value representation, the resulting smooth function is not normalized to one. A set of normalization constants are calculated off-line and are stored in the array elements RELWMN(ISCN,ICOLAT,2) and ALBMN(ISCN,ISUN,3) for longwave and shortwave, respectively.

So, the normalized model value, $A_N(x,y)$ is

$$A_N(x,y) = A(x/y)C_N$$

where

$$C_N = \left\{ \begin{array}{c} \text{RELWMN(ISCN,ICOLAT,2)} \\ \text{or} \\ \text{ALBMN(ISCN,ISUN,3)} \end{array} \right. .$$

Specifically, subroutine RVALUE is invoked from subroutine SCNID (see Section 5.2.2.1) and performs a tri-linear interpolation calculation between grid points of the **RMATRX** array (see Tables A-6a, A-6b, and A-6c) to find the required shortwave bidirectional model value. The interpolation is over spacecraft zenith (θ_s'), relative azimuth (ϕ_r), and solar zenith (θ_o') bins of **RMATRX**.

The interpolation value is given by

```
R = (CVZEN*CRAZ*RMATRX(ISCENE,ISZEN  ,IVZEN,   IRAZ  ,1)
   + FVZEN*CRAZ*RMATRX(ISCENE,ISZEN  ,IVZEN+1,IRAZ  ,1)
   + CVZEN*FRAZ*RMATRX(ISCENE,ISZEN  ,IVZEN  ,IRAZ+1,1)
   + FVZEN*FRAZ*RMATRX(ISCENE,ISZEN  ,IVZEN+1,IRAZ+1,1)
       * CSZEN / ALBMN(ISCENE,ISZEN,3)
   + (CVZEN*CRAZ*RMATRX(ISCENE,ISZEN+1,IVZEN  ,IRAZ  ,1)
   +  FVZEN*CRAZ*RMATRX(ISCENE,ISZEN+1,IVZEN+1,IRAZ  ,1)
   +  CVZEN*FRAZ*RMATRX(ISCENE,ISZEN+1,IVZEN  ,IRAZ+1,1)
   +  FVZEN*FRAZ*RMATRX(ISCENE,ISZEN+1,IVZEN+1,IRAZ+1,1)
       * FSZEN / ALBMN(ISCENE,ISZEN+1,3)
```

where

$$FVZEN = \frac{\theta_s' - GVZEN(IVZEN)}{GVZEN(IVZEN+1) - GVZEN(IVZEN)} ,$$

$$CVZEN = 1. - FVZEN ,$$

$$FRAZ = \frac{\phi_r - GRAZ(IRAZ)}{GRAZ(IRAZ+1) - GRAZ(IRAZ)} ,$$

$$CRAZ = 1. - FRAZ ,$$

$$FSZEN = \frac{(1. - CSUN) - GSZEN(ISZEN)}{GSZEN(ISZEN+1) - GSZEN(ISZEN)} ,$$

and

$$CSZEN = 1. - FSZEN \quad .$$

Tables G-1, G-2, and G-3 show the grid values of RMATRX along spacecraft zenith, relative azimuth, and solar zenith that are used in the interpolation equations above.

Notice that values contained in **GVZEN**, **GRAZ**, and **GSZEN** are actually the centers of the spacecraft zenith, relative azimuth, and solar zenith bins, respectively, except for the end points (see Tables 5.2-11b, 5.2-11c, and 5.2-11a).

The array (ALBMN(ISCENE,ISZEN,3) (see Tables A-6a, A-6b, and A-6c) contains normalization constants. These constants are used to normalize the interpolated function as described above.

Table G-1. Spacecraft Zenith Interpolation Intervals

Spacecraft Zenith Interpolation Intervals	IVZEN	GVZEN(IVZEN)
$0° \le \theta_s' \le 21°$	1	0^o
$21° < \theta_s' \le 33°$	2	21^o
$33° < \theta_s' \le 45°$	3	33^o
$45° < \theta_s' \le 57°$	4	45^o
$57° < \theta_s' \le 69°$	5	57^o
$69° < \theta_s' \le 90°$	6	69^o
	7	90^o

Table G-2. Relative Azimuth Interpolation Intervals

Relative Azimuth Interpolation Intervals	IRAZ	GRAZ(IRAZ)
$0° \le \phi_r' \le 20°$	1	0^o
$20° < \phi_r' \le 45°$	2	20^o
$45° < \phi_r' \le 75°$	3	45^o
$75° < \phi_r' \le 105°$	4	75^o
$105° < \phi_r' \le 135°$	5	105^o
$135° < \phi_r' \le 160°$	6	135^o
$160° < \phi_r' \le 180°$	7	160^o
	8	180^o

Table G-3. Solar Zenith Interpolation Intervals

Solar Zenith Interpolation Intervals ($CSUN = \cos(\theta_0')$)		ISZEN	GSZEN(ISZEN)
$0.0° \leq \theta_0' \leq 31.8°$	$0.0 \leq 1. - CSUN \leq 0.15$	1	0.0
$31.8° < \theta_0' \leq 41.4°$	$0.15 < 1. - CSUN \leq 0.25$	2	0.15
$41.4° < \theta_0' \leq 49.5°$	$0.25 < 1. - CSUN \leq 0.35$	3	0.25
$49.5° < \theta_0' \leq 56.6°$	$0.35 < 1. - CSUN \leq 0.45$	4	0.35
$56.6° < \theta_0' \leq 63.3°$	$0.45 < 1. - CSUN \leq 0.55$	5	0.45
$63.3° < \theta_0' \leq 69.5°$	$0.55 < 1. - CSUN \leq 0.65$	6	0.55
$69.5° < \theta_0' \leq 75.5°$	$0.65 < 1. - CSUN \leq 0.75$	7	0.65
$75.5° < \theta_0' \leq 81.4°$	$0.75 < 1. - CSUN \leq 0.85$	8	0.75
$81.4° < \theta_0' \leq 90.0°$	$0.85 < 1. - CSUN \leq 1.00$	9	0.85
		10	1.00

G.13 SUBROUTINE AVALUE (G.5.13)

Subroutine AVALUE is invoked from subroutine SCNID (see Section 5.2.2.1) and performs a bi-linear interpolation calculation between grid points of the **AMATRX** array (see Table A-6a, A-6b, and A-6c) to find the required longwave anisotropic model value.

The interpolation is over spacecraft zenith $(\theta_s)'$ bins and colatitudinal (θ) bins. This technique is generally illustrated in Section G.12.

Specifically, in this routine, the interpolated value is given by

```
A = (CVZEN * AMATRX(ISCENE,IVZEN,ICOLAT,1)
   + FVZEN * AMATRX(ISCENE,IVZEN+1,ICOLAT,1))
           * CCOLAT/RELWMN(ISCENE,ICOLAT,2)
   + (CVZEN * AMATRX(ISCENE,IVZEN,ICOLAT+1,1)
   +  FVZEN * AMATRX(ISCENE,IVZEN+1,ICOLAT+1,1))
            * FCOLAT/RELWMN(ISCENE,ICOLAT+1,2)
```

where

$$\mathrm{FVZEN} = \frac{\theta_s' - \mathrm{GVZEN(IVZEN)}}{\mathrm{GVZEN(IVZEN+1)} - \mathrm{GVZEN(IVZEN)}} ,$$

$$\mathrm{CVZEN} = 1. - \mathrm{FVZEN} ,$$

$$\mathrm{FCOLAT} = \frac{\theta - \mathrm{GCOLAT(ICOLAT)}}{\mathrm{GCOLAT(ICOLAT+1)} - \mathrm{GCOLAT(ICOLAT)}} ,$$

and

$$\mathrm{GCOLAT} = 1. - \mathrm{FCOLAT}$$

Tables G-1 and G-4 show the grid values of **AMATRX** along spacecraft zenith and colatitude that are used in the interpolation equations above.

Table G-4. Colatitudinal Interpolation Intervals

Colatitudinal Interpolation Intervals	ICOLAT	GCOLAT(ICOLAT)
$0° \le \theta \le 27°$	1	$0°$
$27° < \theta \le 45°$	2	$27°$
$45° < \theta \le 63°$	3	$45°$
$63° < \theta \le 81°$	4	$63°$
$81° < \theta \le 99°$	5	$81°$
$99° < \theta \le 117°$	6	$99°$
$117° < \theta \le 135°$	7	$117°$
$135° < \theta \le 153°$	8	$135°$
$153° < \theta \le 180°$	9	$153°$
	10	$180°$

Notice that the values contained in **GVZEN** and **GCOLAT** are actually the centers of the spacecraft zenith and colatitudinal bins, respectively, except for the end points (see Tables 5.2-11b and 5.2-11d).

The array RELWMN(ISCENE,ICOLAT,2) (see Tables A-6a, A-6b, and A-6c) contains normalization constants. These constants are used to normalize the interpolated function as described in Section G.12.

G.14 SUBROUTINE ABEND (G.5.14)

In the event that a fatal error is encountered during processing of SIPOST, subroutine ABEND is called to dump the value of each parameter in every COMMON block used by the Post-Processor. The information is written to TAPE6. Parameter values are displayed in the same order as they appear in their associated COMMON block. The COMMON blocks are displayed in alphabetical order.

A message indicating the abnormal termination of the Post-Processor is written to the ERBE diagnostic message file, TAPE95, as well as to TAPE6. ABEND also calls subroutine INPPPS (#5.5.3) to generate the processing summary report, QC-27.

G.15 SUBROUTINE PATBUF (G.5.15)

Subroutine PATBUF copies PAT* data records to the PAT60 and/or the scene validation data (ID-4) product in the event that nonscanner data is not available. PATBUF buffers in the **XPAT** array from PAT* and then writes it directly to the requested output products. The processing flow is similar to that of subroutine DATRUN (#5.5.2), but PATBUF does not have the capability to provide nonscanner data. See the discussion and flow diagram in Section 5.5.2.

G.16 SUBROUTINE DPACK (G.5.16)

Subroutine DPACK applies the appropriate scale factors and offsets to elements of the input array **X** and produces the output array **IOUT**. The **X** array along with the scale factor and offset arrays, **SF** and **OFF**, are passed from the calling routine. INDEX is the location of the first word in IOUT to be loaded with the scaled and offset values, and NUM is the number of IOUT elements to be filled. MAX is the maximum value that can be represented by IOUT. XER and IER are the real and integer Inversion Subsystem default values. INDEX, NUM, MAX, XER, and IER are passed to DPACK by the calling routine.

If an element of **X** is equal to XER the corresponding element of **IOUT** will be set equal to IER. Otherwise, the corresponding element of **IOUT** is calculated as follows.

IOUT(I) = ((X(I) + OFF(I)) * SF(I))

After IOUT(I) is calculated, it is determined whether its absolute value exceeds the maximum value allowed. If this is the case, IOUT(I) is set equal to IER.

Figure G-19 is a flowchart of DPACK.

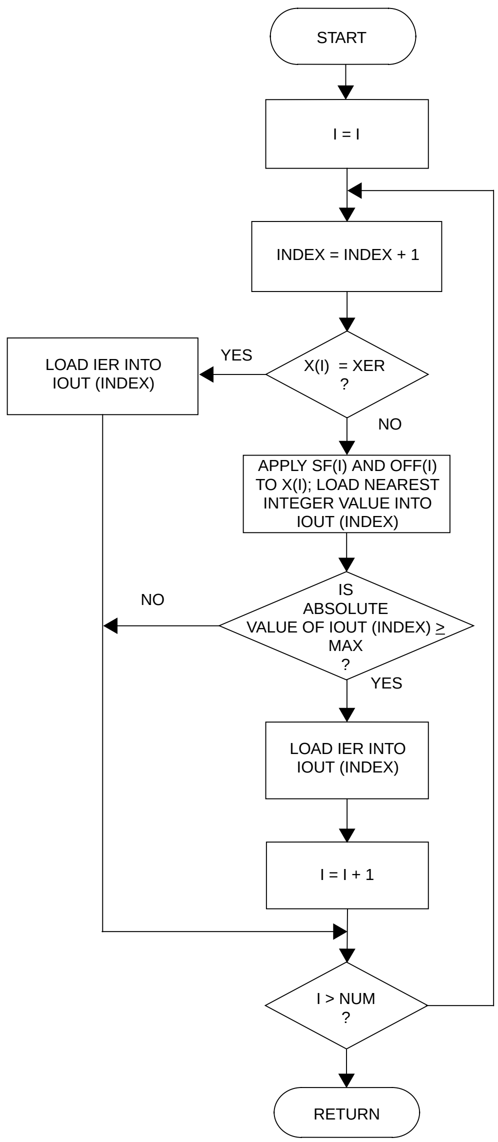


Figure G-19. Flowchart of DPACK (Module G.5.16)

G.17 SUBROUTINE FILWRT (G.5.17)

Subroutine FILWRT unscales a PAT data record after it has been unpacked, then prints out the record contents, five elements per line. Input parameters to routine FILWRT are NUMOUT, the number of words in the PAT record, IUPAT, the PAT record in integer form, XERROR, the real Subsystem default value, PATSF, an array of scale factors, PATOFF, an array of offsets, and DESC, a character string used to provide descriptive information when writing out the record contents. IUNOUT, the unit number of the designated file for printing, is also an input parameter to FILWRT. No output parameters are used. Figure G-20 contains the flowchart of FILWRT.

FILWRT examines each element of the integer form PAT records sequentially. Based on the element contents, a corresponding value is generated in a real PAT record. If the element is found to contain the integer form subsystem default value, the corresponding element of the real PAT record is set to XERROR, the real default value. The nondefault values are unscaled using corresponding elements from the scale factor and offset arrays according to

.

$$\text{Real Quantity} = \frac{\text{Integer Scaled Quantity}}{\text{Scale Factor}} - \text{Offset} \ .$$

Once the input data array has been unscaled, the record contents are written, five elements per line, to the local file associated with IUNOUT. FILWRT then returns control to the calling routine.

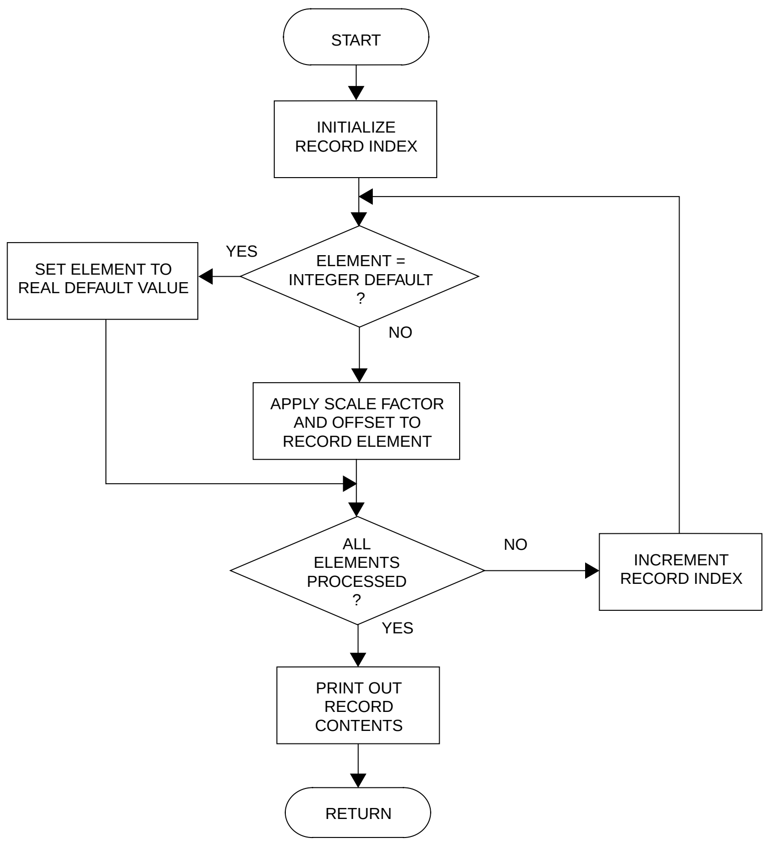


Figure G-20. Flowchart of FILWRT (Module G.5.17)

G.18 SUBROUTINE HPACK (G.5.18)

Subroutine HPACK generates an integer array, **IARRAY**, from a real array, **ARRAY**. This is done by using the FORTRAN intrinsic function, NINT, which takes the nearest integer value of a real value. IBEG and IEND are pointers to the first and last elements of **ARRAY** to be processed. INDEX is the pointer to the first IARRAY element to be loaded with an integer value. IBEG, IEND, INDEX, and **ARRAY** are passed to HPACK from the calling routine.

Figure G-21 is a flowchart of HPACK.

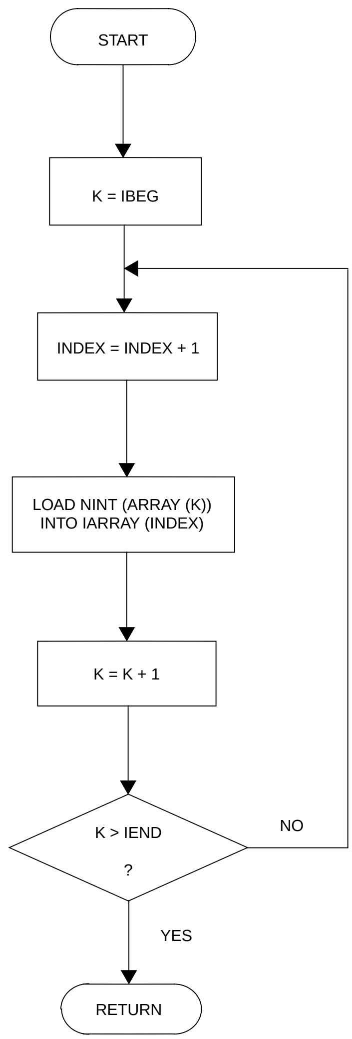


Figure G-21. Flowchart of HPACK (Module G.5.18)

G.19 FUNCTION PARMGT (G.5.19)

Function PARMGT retrieves a single parameter from the execution control statement and returns that value as the value of the function. PARMGT uses no input parameters. Figure G-22 contains the flowchart of PARMGT.

PARMGT retrieves a parameter from the execution control statement through a call to the CDC supplied FTN5 routine GETPARM. GETPARM returns the parameter name in the character string PARMNM; the actual parameter value is returned in character string PARMVL. IRCODE is the integer return code, set by GETPARM to indicate normal or abnormal return. Immediately following the call to GETPARM, PARMGT checks the return code. If IRCODE is equal to a nonzero value, indicating an abnormal return, SYSMSG (#G.E.8.4.1) is invoked for error handling and termination processing. If the call to GETPARM results in a normal return, the function value is set to the fetched parameter value, and control is returned to the calling routine.

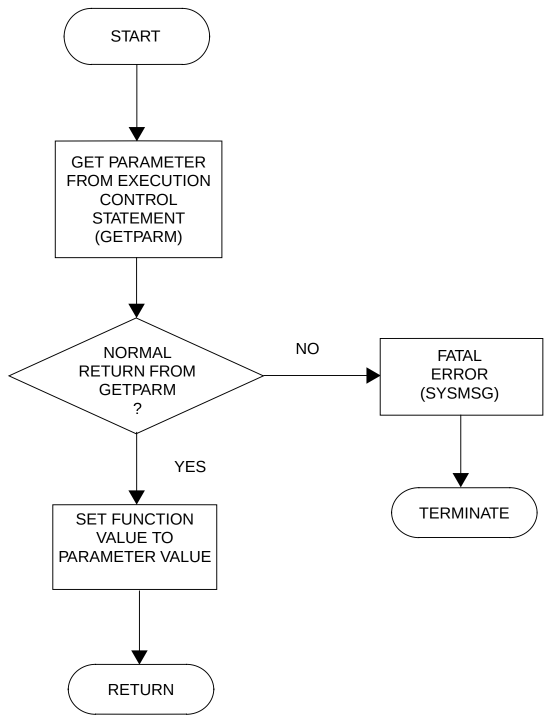


Figure G-22. Flowchart of PARMGT (Module G.5.19)

G.20 SUBROUTINE PPSPEC (G.5.20)

Subroutine PPSPEC prints out product specifications that include the following data characteristics: temporal span, spacecraft name, product name, volume serial number (VSN) or file identifier on which the product resides, and the ERBE logical header associated with the product. Input parameters to PPSPEC are IUNOUT, the unit number designated for the printed output, **IBUF**, the array containing the ERE logical header, IPCN, the integer product code, PRODCD, a character string containing product name, and VSNFN, the character string containing the VSN or file name. PPSPEC has no output parameters. Figure G-23 contains the flowchart of PPSPEC.

PPSPEC first checks to see if a request has been made to verify the product code. This request is signified by a nonzero value passed for PRODCD. If verification is requested, function IVLHED (#G.E.8.3.9) is invoked to perform the necessary analysis. If the call to IVLHED results in verification failure, then routine SYSMSG (#G.E.8.4.1) is invoked to handle error processing and terminate execution. If verification is unsuccessful, or if no verification is required, NAMELIST $NAMGLB, containing ERBE System processing constants, is then read. See Reference 5 for the structure and contents of $NAMGLB. Function JULCHR (#G.E.8.5.9) is then invoked to translate the header buffer Julian date values to a temporal representation in character form. The spacecraft name is then determined by indexing with spacecraft integer code into ISCNAM, a character array of spacecraft names defined during the read of $NAMGLB. At this point, all specifications are defined and ready for printing. The specifications are then printed out in the following order: temporal span, spacecraft name, product name, VSN or file name, and ERBE logical header array. Control is then returned to the calling routine.

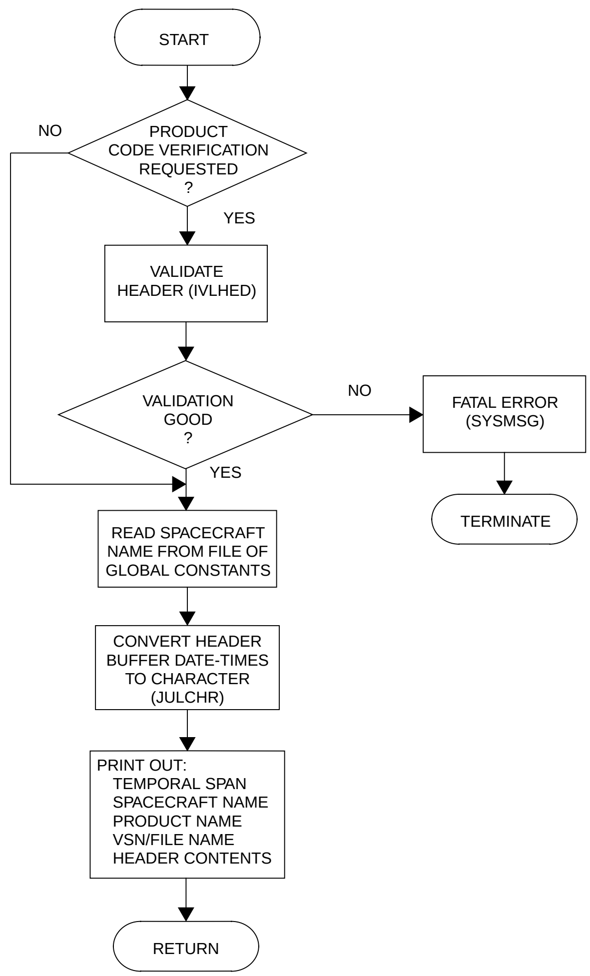


Figure G-23. Flowchart of PPSPEC (Module G.5.20)

G.21 SUBROUTINE PRPHED (G.5.21)

Subroutine PRPHED reads, unpacks, and prints the header contents from an external output form file. Input parameters to PRPHED are IUNIT, the unit number of the file containing the physical header record, and IUNOUT, the unit number designated for printed output. PRPHED has no output parameters. Figure G-24 contains the flowchart of PRPHED.

PRPHED rewinds IUNIT to beginning-of-information. The physical header is then read directly into array **IHEAD**. If an error is encountered when reading the header, SYSMSG (#G.E.8.4.1) is invoked to perform error handling and terminate processing. Following a successful read, the end-of-file mark on IUNIT is processed. Routine SPREAD (#G.E.8.6.4) is then invoked to unpack the header data stored in **IHEAD**. Upon return from SPREAD, the physical header contents are printed. These include: subsystem indicator, product code, spacecraft indicator, whole and fractional Julian date, processed version counter, and date and time processed. Control is then returned to the calling routine.

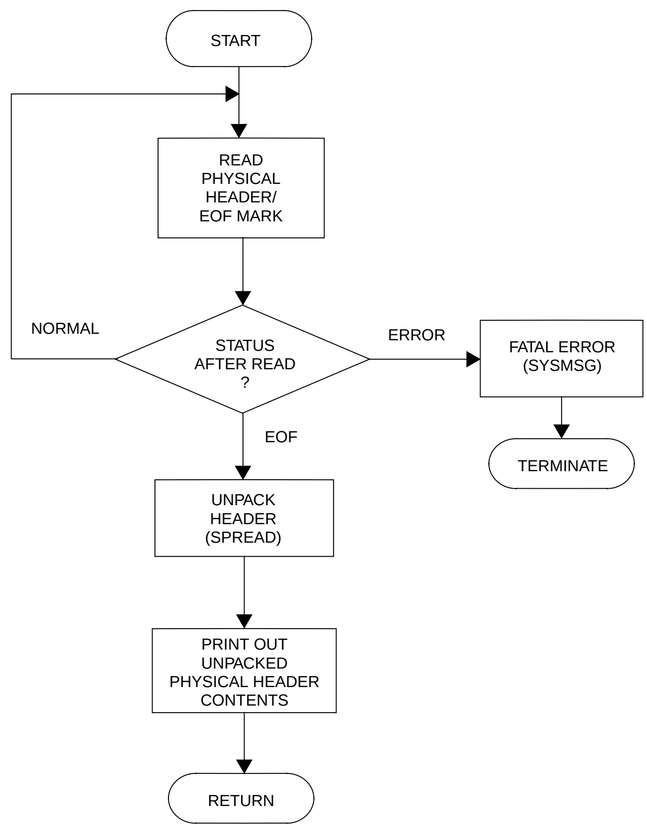


Figure G-24. Flowchart of PRPHED (Module G.5.21)

G.22 SUBROUTINE RECRNG (G.5.22)

Subroutine RECRNG extracts two parameters from the execution control statement, translates these character values into integer format, and then checks to see if the integer values represent a valid range of records for dumping purposes. NUMREC, the total number of records on the input product, is an input parameter to RECRNG. RECRNG has two output parameters, IBEG, the integer value corresponding to the initial record identifier, and IEND, the integer value corresponding to the final record identifier. Figure G-25 contains the flow chart of RECRNG.

RECRNG invokes function PARMGT (#G.5.19) to extract a parameter from the execution control statement. This value is returned in the character string PARMVL. PARMVL is then translated into the integer IBEG by means of an internal read. PARMGT is then invoked a second time, to fetch the next parameter on the execution control statement. The returned value, PARMVL, is once again translated into integer form, IEND, by means of an internal read. Once the record identifiers are translated into integer form, they are checked to see if they represent a valid record interval.

If either the initial or final record is less than zero or greater than the total number of records on the product, or if the final record identifier is less than the initial record identifier, an illegal record interval has been detected, and SYSMSG (#G.E.8.4.1) is invoked to perform error handling and terminate processing. Note that a zero value is considered an acceptable record identifier. This condition is used to communicate the request to dump no data records. Once a valid range of records is determined, control is returned to the calling routine.

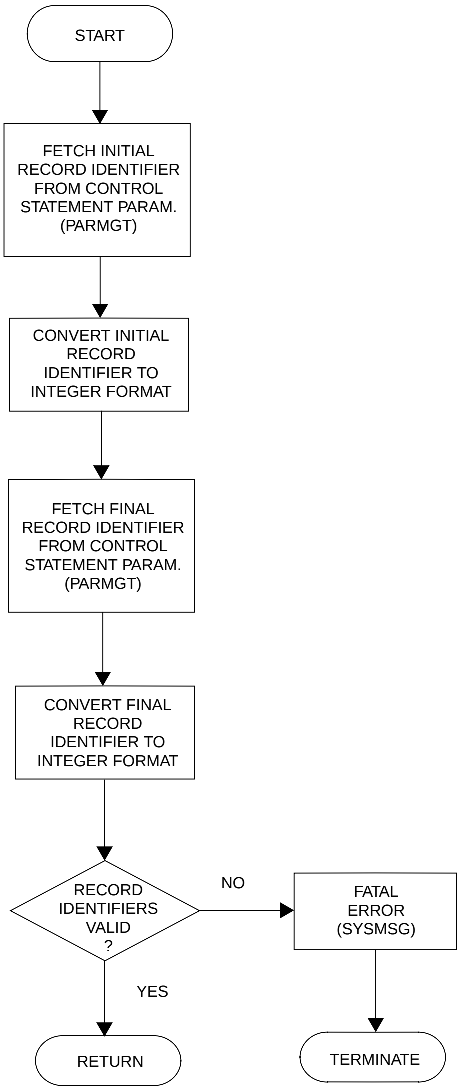


Figure G-25. Flowchart of RECRNG (Module G.5.22)

G.23 SUBROUTINE ID12RD (G.5.23)

Subroutine ID12RD reads data blocks from one Daily Medium-Wide FOV Data Tape data file and writes them to another file. Unit numbers for the input and output files are passed to ID12RD from the calling routine, and a count of the blocks copied is returned to the calling routine.

G.24 SUBROUTINE ID13RD (G.5.24)

Subroutine ID13RD reads records from one daily Earth Target Validation Data file and writes them to another file. Unit numbers for the input and output files are passed to ID13RD from the calling routine, and a count of the records copied is returned to the calling routine.

G.25 SUBROUTINE DVALUE (G.5.25)

Subroutine DVALUE is invoked from subroutine SCNID (see Section 5.2.2.1) and performs a linear interpolation calculation between grid point of the **ALBMN** array (see Tables A-6a, A-6b, and A-6c) to find the required albedo and directional model values.

The interpolation is over solar zenith bins. The technique is generally illustrated in Section G.12 and is also implemented in subroutines RVALUE (#G.5.12) and AVALUE (#G.5.13).

Specifically, in this routine, the interpolated value for albedo is given by

$$\text{ALB} = \text{CSZEN} * \text{ALBMN(ISCENE, ISZEN,1)} + \text{FSZEN} * \text{ALBMN(ISCENE, ISZEN +1,1)},$$

where

$$\text{FSZEN} = \frac{(1.- \text{CSUN}) - \text{GSZEN(ISZEN)}}{\text{GSZEN(ISZEN+1)} - \text{GSZEN(ISZEN)}},$$

and

$$\text{CSZEN} = 1. - \text{FSZEN}.$$

Table G-3 shows the grid values of **ALBMN** along solar zenith bins that are used in the interpolation process.

Notice that values contained in **GSZEN** are actually the centers of the solar zenith bins, except for the end points (see Table 5.2-11a).

APPENDIX H

INVERSION SUBSYSTEM SOFTWARE/CONTROL LANGUAGE INTERFACE

H.1 GENERAL

Inversion Subsystem software and job control language (JCL) are designed to allow the user to easily select and execute alternative Inversion Subsystem options and processing directives. Two main files, DOYLE and PINVSS, are used to accomplish job creation, submittal, and execution. Procedure INV, residing on file DOYLE, is an interactive menu-driven procedure that presents the user with Inversion Subsystem processing options; once an option is selected, INV generates a submit file which in turn invokes a procedure on file PINVSS to process the request.

The general categories of processing choices presented by procedure INV are product generation, product copying, and product listing. Once a processing option is selected, the user is prompted for the information necessary to execute the requested option. After all prompts are answered, a submit file containing the request is generated, and the user can then select to have the job routed for execution.

PINVSS, the multiprocedure file that drives Inversion Subsystem software, contains JCL to execute any processing request. The entry point into PINVSS is the procedure name, generated by INV, that is specified in the Inversion Subsystem submit file. The parameters passed to that procedure may then be used to define a processing path through the JCL, specify file names or tape volume serial numbers (VSN) used in the processing, or define variables used within the procedure or passed to the executing software. Note that certain output product designators are derived from keyboard entry. See Section H.3 for Inversion Subsystem product naming conventions.

H.2 MAIN-PROCESSOR AND POST-PROCESSOR CONTROL LANGUAGE INTERFACE

Procedure parameters are used during the execution of the Inversion Subsystem Main-Processor and Post-Processor to accomplish input file selection, input-PAT product verification, output product naming and selection, and optional module execution, as described by the following items:

1. Parameters are used to determine input file selection. Values for data date are used to select scene identification files that vary monthly and seasonally. A spacecraft parameter is used to determine the file names of spectral correction coefficients, quadrature weights, and scene independent shape factor coefficients. Table A-1a includes information regarding naming conventions used for files that are either data date or spacecraft dependent.

2. Parameters are used to verify the input-PAT. Values for data date and spacecraft are passed from the procedure to the executing Main-Processor; these values are compared to data date and spacecraft code derived from the input-PAT (see subroutine CHKREQ #5.1.4). Program execution terminates if data date and spacecraft code determined from keyboard entry do not match those of the input-PAT.

3. Parameters are used to determine input and output product requests. When a request is made to process the Main-Processor and Post-Processor, product VSNs and file names are generated by INV and passed as parameters to PINVSS. If a product is not requested for generation, a special parameter value, NREQ, is passed in place of VSN or file name. The passed parameters are used to define the contents of a local file, which is in turn read by subroutine CHKREQ in the Main-Processor; the Main-Processor turns off all products that have the value NREQ and communicates request information (see ID-21) to the Post-Processor. In addition, throughout the JCL, any reference to an operation on a product not selected is skipped. Note that file names generated by INV for the ID-12, ID-13, ID-21, and a quality control archival file are derived from keyboard entry for data date and spacecraft. See Section H.3 for Inversion Subsystem output product naming conventions.

4. Parameters are used to determine optional module execution. When a request is made to PINVSS to process the Main-Processor and Post-Processor, on/off flags are passed to indicate selection of module execution. Based on the flag values, the Main-Processor and Post-Processor are conditionally executed.

H.3 INVERSION SUBSYSTEM OUTPUT PRODUCT NAMING CONVENTION

The Inversion Subsystem uses naming conventions, based on data set descriptors, to name output products used both locally and off-site. As product requests are made through the execution of procedure INV (see Section H.1), file names and magnetic tape VSNs are derived based on keyboard entry for data date and spacecraft information, as well as version and copy numbers where applicable.

The daily Medium-Wide FOV Data Tape (daily MWDT, ID-12), the daily Earth Target Validation Data (daily ETVD, ID-13), the Output Data to the Inversion Subsystem Post-Processor (ID-21), and a quality control archival file are generated during the execution of the Inversion Subsystem Main-Processor and Post-Processor; they exist on indirect access files, and the file names are descriptive of the data set contained. In addition, the MWDT (S-7) and the PAT (S-8), residing on magnetic tape intended for off-site distribution, have VSNs chosen to describe the data set they contain. Tables H-1 and H-2 illustrate the naming conventions used. Table H-1 contains product identifiers, along with the meaning of each character position within the file name or VSN. Table H-2 contains mapping information that allows a user to interpret a specific character value. In each column of Table H-2, the entry to the right of the equal sign represents a character found in a file name or VSN; the value to the left represents the interpretation of the character code.

Given the example of the ID-12 file 0IM25DB, character positions one through three represent fixed values that identify the file using ERBE naming conventions. Character position four, with a satellite code of ‘2’, indicates that the product contains data for spacecraft ERBS. Character position five with a year designation of ‘5’, character position six with a month designation of ‘B’, and character position seven with a day designation of ‘D’ indicate that the data date associated with this product is February 4, 1985.

Note that the character representation for year can be either an alpha or numeric code. This representation, used for the S-7 and S-8 products, allows a user to distinguish between products derived from an Inversion Subsystem run made on the production account (alpha code) from a non-production environment (numeric code).

Table H-1. Inversion Subsystem Product Names

Product	Character Position						
	1	2	3	4	5	6	7
ID-12	‘O’	‘I‘	‘M’	satellite	year	month	day
ID-13	‘O’	‘I‘	‘E’	satellite	year	month	day
ID-21	‘N’	‘I‘	‘P’	satellite	year	month	day
QC Report[1]	‘Q’	‘I‘	‘P’	satellite	year	month	day
S-7	‘7’	satellite	month	year	version	‘6’	copy
S-8	‘8’	satellite	month	year	version	day	copy
V-6	‘V’	satellite	month	year	version	‘6’	copy

NOTES: 1. The quality control archival file contains the processing summaries for both the Main-Processor and Post-Processor, associated ERBE Production Error Reports, ERBE File Activity Reports, a copy of the Inversion tape catalog, and the related job dayfile.

Table H-2. Character Mapping Table

Satellite	Month	Day	Year	Version	Copy
NOAA 9 = 1	Jan = A	1 = A	1984 = 4/D	1 = A	1 = 1
ERBS = 2	Feb = B	2 = B	1985 = 5/E	2 = B	2 = 2
NOAA 10 = 3	Mar = C	3 = C	1986 = 6/F	3 = C	3 = 3
	Apr = D	4 = D	1987 = 7/G	4 = D	4 = 4
	May = E	5 = E	1988 = 8/H	5 = E	5 = 5
	Jun = F	6 = F	1989 = 9/I	6 = F	6 = 6
	Jul = G	7 = G		7 = G	7 = 7
	Aug = H	8 = H		8 = H	8 = 8
	Sep = I	9 = I		9 = I	9 = 9
	Oct = J	10 = J		10 = J	10 = A
	Nov = K	11 = K		11 = K	11 = B
	Dec = L	12 = L		12 = L	12 = C
		13 = M		13 = M	13 = D
		14 = N		14 = N	14 = E
		15 = O		15 = O	15 = F
		16 = P		16 = P	16 = G
		17 = Q		17 = Q	17 = H
		18 = R		18 = R	18 = I
		19 = S		19 = S	19 = J
		20 = T		20 = T	20 = K
		21 = U		21 = U	21 = L
		22 = V		22 = V	22 = M
		23 = W		23 = W	23 = N
		24 = X		24 = X	24 = O
		25 = Y		25 = Y	25 = P
		26 = Z		26 = Z	26 = Q
		27 = 1		27 = 1	27 = R
		28 = 2		28 = 2	28 = S
		29 = 3		29 = 3	29 = T
		30 = 4		30 = 4	30 = U
		31 = 5		31 = 5	31 = V
				32 = 6	32 = W
				33 = 7	33 = X
				34 = 8	34 = Y
				35 = 9	35 = Z

H.4 OPERATIONAL INSTRUCTIONS

For an in-depth description of the Inversion Subsystem menu procedure, INV, the execution driver, PINVSS, sample menu sessions, JCL submit file examples, and associated error messages, refer to the Inversion Subsystem Operators' Guide (see Reference 11).